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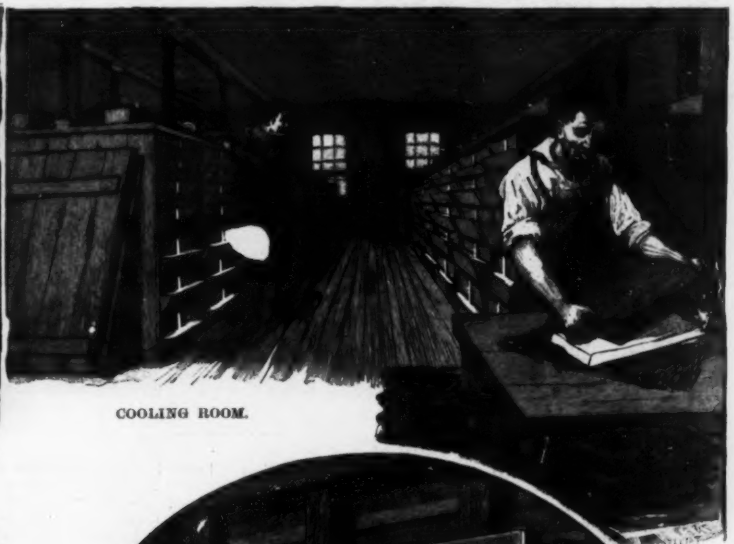
DIPPING CANDLES—THE OLD METHOD.



COOLING ROOM.

THE MANUFACTURE OF CANDLES.

It is only the history of the modern candle that is written—the graceful, sightly, and tapering cylinder which burns with a clear white and brilliant light; that neither smokes nor "drips;" which retains its hardness in the hottest weather; which can always be handled without greasing the fingers, and requires no snuffing. The primitive character of the candles by which the last generation read its primers and studied its Euclid is a curious phenomenon when viewed as the product of unnumbered centuries of intellectual growth. The vision is easily conjured up in the memory, of their yellow light, their smoke, their unpleasant odor, and their frequent need of attention from a deft hand wielding the old-fashioned snuffers.

One quarter of the nineteenth century had followed its predecessors before it occurred to man that tallow candles might be made hard enough to keep the year round without melting, that the smoke was caused by imperfect combustion, that the substance which hindered a perfect burning might be removed from the fat, and that a simple method might be contrived to make snuffing unnecessary.

COLD PRESSING.

THE DIGESTER.

HOT PRESSING.

HOW CANDLES ARE MADE—MANUFACTORY OF PROCTER & GAMBLE, CINCINNATI, OHIO.

These remedies, simple as they were, had to wait for riper scientific knowledge than even the savants of the last century possessed. A condition precedent was a knowledge of the nature of fats and of that energetic display of chemical action which we now call combustion.

The progressive steps in candle making from the age of the primeval savage up to the nineteenth century were not many. First the pine knot, then the oil nuts on a skewer, which is now the means of illuminating used by the Otaheitans and Society Islanders, who are not far behind the rural housewife of not long ago, who hardened rushes, peeled them on one side, and soaked the pith in the skimmings of the bacon pot, or our mothers, who hung a row of wicks of cotton yarn upon a stick, and dipped the wicks into the melted tallow prepared only by the removal of the membranes, etc., in the shape of cracklings. The operation had to be repeated several times, until sufficient tallow had hardened around the wick to make a not very shapely cylinder, the sticks being supported, while the tallow cooled, by parallel bean poles or quilting frames. Dipping day then was not looked forward to with pleasure by the cleanly housewife; it was dirty work at best—the kitchen floor was bound to suffer unless the weather permitted the dipping to be done in the yard or under the cover of the woodshed. Cool days in the spring or fall were chosen, so that the tallow might harden quickly and evenly, and if the attic supply gave out in the midst of warm weather, the grocery had to be patronized for the crude mould candles just coming into use. In those days the construction of kettles specially adapted to melting the tallow and keeping it at an even temperature, and a contrivance for expediting the dipping by putting the rods with the row of looped wicks upon a revolving rack, marked substantially all the advance of the tallow chandler's art. Aided by all these appliances, a workman could dip probably three or four thousand candles in a long day, and congratulate himself on his luck and his skill, but in the warm weather he had to do the dipping in the cool of the very early morning, and doubtless he often wondered if the time would come when his work could proceed in defiance of the temperature. This method of dipping candles for the trade came down to our own day. Moulds were invented in Paris in the eighteenth century, but it was not until the whole process of candle making had undergone a change that they came into general use and stopped the domestic manufacture. The history of tallow candle making up to the invention of the modern method is a curious one, because of the long time that the crude methods obtained, and it has its complement in the fact that wax candles are still made by kneading the softened wax to the wick with the fingers; the candle is then given a symmetrical shape by rolling it between marble or wooden slabs. Moulds cannot be used here because of the great shrinkage which melted wax undergoes while cooling. Doubtless the wax candles were made in this way which King Alfred caused to be marked into divisions and shut up in his horn lantern, that by their graduated burning he might apportion his hours to study and devotion and sleep. Asser's "Life of Alfred" preserves the great king's directions: "He commanded his chaplain to supply wax in sufficient quantities, and he caused it to be weighed in such a manner that when there was so much of it as would equal the weight of seventy-two pence, he caused the chaplain to make six candles thereof, each of equal length, so that each candle might have twelve divisions marked across it." Each of these divisions burned one-third of an hour, so that the six candles lasted one day.

THE BLEACH.

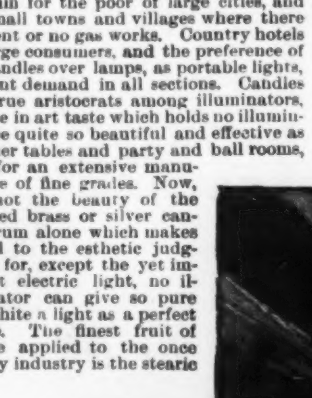
The discovery of gas lighting and improvements in lamps have done much to curtail the manufacture of candles, but it is yet a vast industry. An estimate of the consumption in the United States places it at 22,000,000 pounds annually. Candles are still the staple illuminating medium for the poor of large cities, and for all classes in small towns and villages where there are either insufficient or no gas works. Country hotels and taverns are large consumers, and the preference of many people for candles over lamps, as portable lights, keeps up a constant demand in all sections. Candles likewise are the true aristocrats among illuminators, and the renaissance in art taste which holds no illuminating medium to be quite so beautiful and effective as the candle for dinner tables and party and ball rooms, calls for an extensive manufacture of fine grades. Now, it is not the beauty of the polished brass or silver candelabrum alone which makes appeal to the esthetic judgment, for, except the yet imperfect electric light, no illuminator can give so pure and white a light as a perfect candle. The finest fruit of science applied to the once homely industry is the stearic acid mould candle of to-day, which is not only quite as handsome in appearance as the wax candle, but burns with equal brilliancy and purity, and has to a great extent usurped the place of the more costly light. The mines of the far West share with the boudoirs and salons and dining rooms of the East in the consumption of the best of these candles. A very large proportion of the finest grades goes to Nevada, Colorado, and the other mining States and territories of the Pacific slope, the high temperature of the mines demanding a very hard and pure candle. The old candle would be entirely useless here, for tallow melts at from 90° to 104° Fah., and the temperature of the deep mines of Nevada often reaches 120° and even 130°. A good stearic acid candle will withstand a temperature of from 15° to 10° more than this.

To the vast manufactory of the Procter & Gamble Company, at Ivorydale, the most complete and extensive on this continent, we go for our illustrations and our description of their process, for there the most recent and most perfect of scientific and mechanical appliances are kept at work, and the latest scientific research is constantly utilized. More than one hundred thousand candles are sent out from this factory every day, which, if moulded into one candle, would make it eleven miles in length. Every step of the process through which they pass, from the time the fats are deposited into the emptying room until the pretty cylinders, snugly packed in boxes, are sent to all parts of the world, is full either of interest to the student or of entertainment to the simply curious. For the edification of the seeker after knowledge as well as those whose curiosity interests them in wishing to know "how to make candles," we will give both the scientific and the mechanical means of candle making.

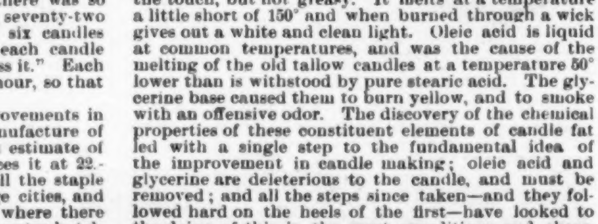
The stearic acid candle, which is now the principal candle of trade, represents the high-water mark of the progress in candle making which began seventy years ago. Unlike its primitive predecessor, the tallow dip, it is a product of scientific study, and one of the many triumphs of philosophic chemistry. The movement which effected a complete revolution in the industry, and ran a rapid growth after once it was started, was an outcome of the discoveries of M. E. Chevreul, the French chemist, published to the world in 1823, in his book, "Recherches sur les Corps Gras d'Origine Animale." In it lies the foundation of all our present knowledge of the chemistry of fatty oils, and this knowledge is the starting point of modern candle making. Chevreul established the scientific fact that, as a rule, all fatty oils, both liquid and solid, are neutral compounds of glycerine and the so-called fatty acids. In tallow and other candle fats, these acids are stearic and oleic.

Stearic acid is a crystalline substance, unctuous to the touch, but not greasy. It melts at a temperature a little short of 150° and when burned through a wick gives out a white and clean light. Oleic acid is liquid at common temperatures, and was the cause of the melting of the old tallow candles at a temperature 50° lower than is withstood by pure stearic acid. The glycerine base caused them to burn yellow, and to smoke with an offensive odor. The discovery of the chemical properties of these constituent elements of candle fat led with a single step to the fundamental idea of the improvement in candle making; oleic acid and glycerine are deleterious to the candle, and must be removed; and all the steps since taken—and they followed hard on the heels of the first—have looked to the doing of this in the most expeditious and cheap manner, and the perfection of the moulding machinery. Naturally the first processes were chemical, but they put a great obstacle of costliness in the way of the manufacture, which almost proved fatal. The early industry, after surmounting this difficulty by combining mechanical means with chemical in separating and purifying the fats, again came near suffering shipwreck from another cause. It was found by the French chandlers, to whom belongs much credit for developing as well as originating the modern method, that the stearic acid on cooling in the mould crystallized, and the candles became unsightly, brittle, and uneven of combustion. The remedy appeared to lie in breaking the grain of the acid, and this was done by the introduction of a powder. Unfortunately, white arsenic was the powder chosen, and the result was so noticeably injurious to health that Chevreul's discoveries were brought into disrepute, and the early art of stearic

SCRAPING OFF SURPLUS.



TEMPERING.

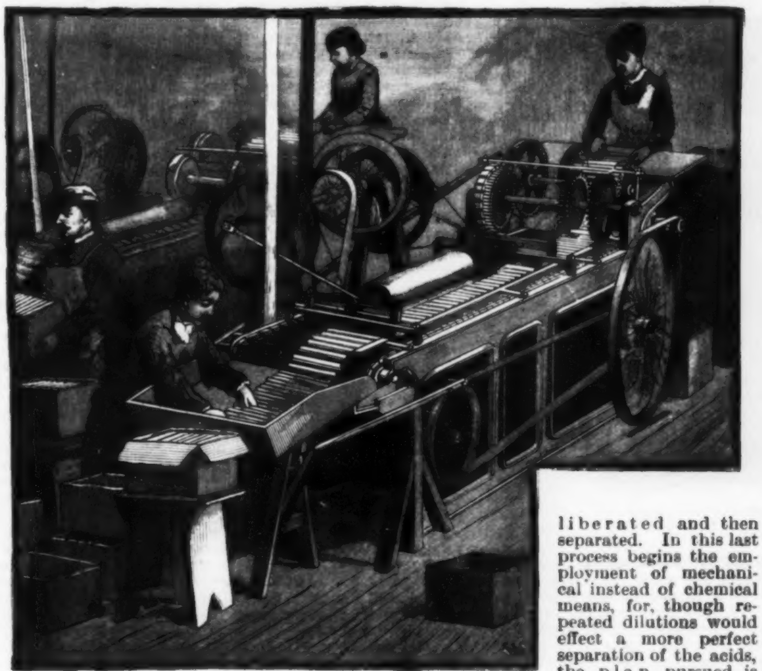


HOW CANDLES ARE MADE—MANUFACTORY OF PROCTER & GAMBLE, CINCINNATI, OHIO.

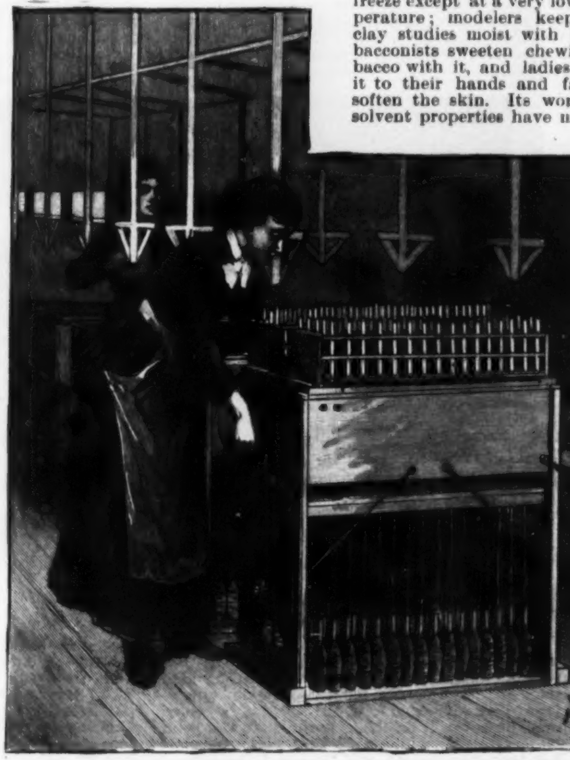
acid candle making was almost annihilated. Better study found a simple and harmless remedy to lie in lowering the temperature of the acid before pouring it into the mould, and in heating the mould to receive it. Improvements were also successively made in the methods of preparing the fat, and when, finally, American ingenuity was brought to bear upon the mechanical side of the problem, a machine was developed out of Sieur de Brez's last-century mould that has marvelously simplified and cheapened the manufacture of candles. The purification of the fat had done much to improve the combustion, and the smoke had been abolished; the flame, too, had become much brighter and clearer, and the snuffing of the wick had become less necessary, for the combustion, being more perfect, the wick, whose only duty is to conduct the oil to the flame, was more nearly consumed. A little attention to the making of wicks soon banished the snuffers and the snuff tray to the curiosity shops of the antiquaries.

The old-fashioned wicks were simply twisted. Cambaceres conceived the plan of plaiting them, with one strand tighter than the others. In the candle the wick is kept straight by the hardened fat, but, when released by the flame, the tightened strand draws the end of the wick over to one side, so that it is brought in contact with the outer envelope of the flame, where the combustion is most perfect because of the liberal supply of oxygen received from the air, and thus the wick is continuously consumed. The process is helped by steeping the wick in boracic acid, in order that a glassy bead may be formed at the end of the wick, and drop off by its own weight. This plan was suggested by De Milly in 1830.

Fortunately a promenade through the factory is in fancy attended with consequences much less disagreeable than in reality, for all that part of the process which is scientifically the most interesting is carried on amid environments that are not the most inviting to a visitor who is afraid of greasy floors and unctuous vats. The moulding, polishing, and packing, however, have picturesque phases which appeal to even the esthetically inclined. Three processes are necessary in the fat for the mould. The glycerine must be removed, the acids must be freed from the new base combined in getting rid of the old, and the solid acids must be separated from the liquid. In the first process the principle followed is the law in chemistry according to which a strong base under favorable conditions will separate a weaker one from its acids by combining with the acids and taking the place of the weaker base. The fat is thereby saponified, a soap being formed, which is next decomposed, the fatty acids liberated and then separated. In this last process begins the employment of mechanical instead of chemical means, for, though repeated dilutions would effect a more perfect separation of the acids, the plan pursued is quicker, cheaper, and sufficiently effective for the purpose desired.



POLISHING.

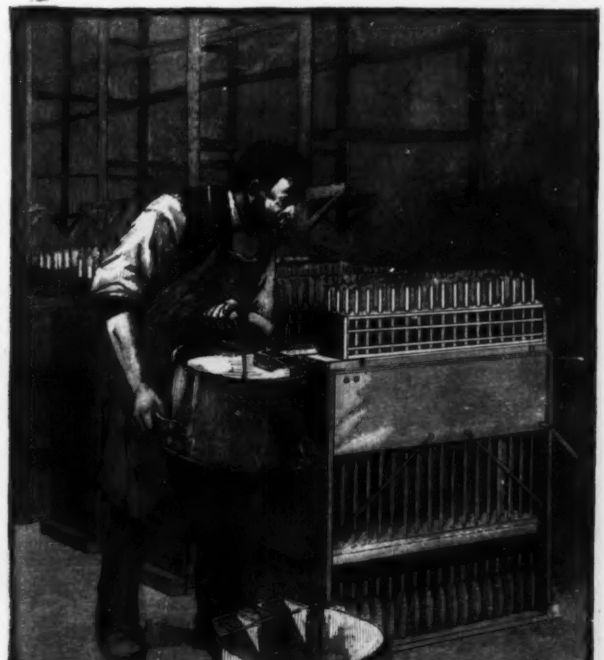


RAISING THE CANDLES.

The saponification of the fat is accomplished in an apparatus called, in chandler's parlance, the "digester." It consists of a copper cylinder inclosed within an iron one, and a pump arranged to force the contents of the inner cylinder from the bottom to the top. Into this, fat which has been melted out of the barrels by steam, is run and is mixed with lime and water. The mixture is heated by steam which is let into the outer cylinder under high pressure. The water, being the heavier, sinks to the bottom of the copper cylinder, whence it is pumped and thrown on a perforated plate above the fat, that it may fall through it in many little streams. This agitation is kept up for eight or nine hours, after which it is found that the lime has united with the fat acids and formed a soap, while the water has consorted with the dissociated glycerine. The contents of the cylinder, after being permitted to remain at rest for a time, separate into two strata, the lime soap on top, the crude glycerine and water below. These are blown off to separate vats by the power of steam. It is the candle factories that furnish one of the main sources of the enormous supply of glycerine which is now a very important article of trade. Formerly it was wasted; now it is refined by the most careful and scientific method and placed upon the market. It is put to a great variety of uses, many of which depend upon its peculiar properties of non-volatility and absorption of atmospheric moisture. Harness makers and leather workers use it in making leather pliable; it is put into gas meters because it does not freeze except at a very low temperature; modelers keep their clay studies moist with it; tobacconists sweeten chewing tobacco with it, and ladies apply it to their hands and faces to soften the skin. Its wonderful solvent properties have made it invaluable in pharmaceutical preparations. Much of it goes into the manufacture of the terrible explosive nitro-glycerine, which is made by treating it with a mixture of sulphuric and nitric acid or concentrated nitric acid. Not less than five million pounds of glycerine are produced by the candle factories and utilized every year in this country, and yet so late as 1854 it was counted as worthless, and was run off into sewers.

When the French chandlers first began the manufacture of the new-process candles, and for a long while after, they permitted the lime soap to become hard, and then ground it up in order to dissociate the lime from the fat acids. Now this is done without delay,

CUTTING AND CARRYING OFF.



MOULDING.

HOW CANDLES ARE MADE—MANUFACTORY OF PROCTER & GAMBLE, CINCINNATI, OHIO.

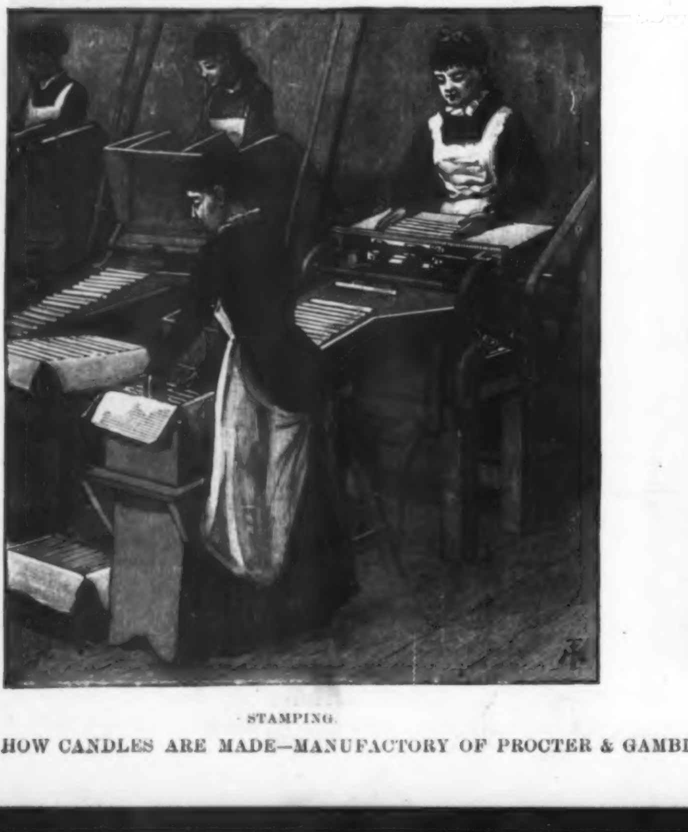
the liquid soap being run into lead-lined vats with a proportion of sulphuric acid added. The chemical principle involved is the same as in the more laborious process of saponification ; the glycerine base has been supplanted by the lime base, and this must now be got rid of. The sulphuric acid takes hold of the lime, forming sulphate of lime, and the acids float off free. In these vats, between which the paths are narrow and the walks greasy, the liquid settles in three strata—the first, the fat acids, now free of their base, but still mingled ; the second, an acid water ; the third, sulphate of lime, a waste. They are easily drawn off without mixing, and the fat acids, by washing in boiling water, are cleaned of all traces of the sulphuric acid. We are now done with the chemical processes. Our product is a fat which contains the solid and

HAND POLISHING.

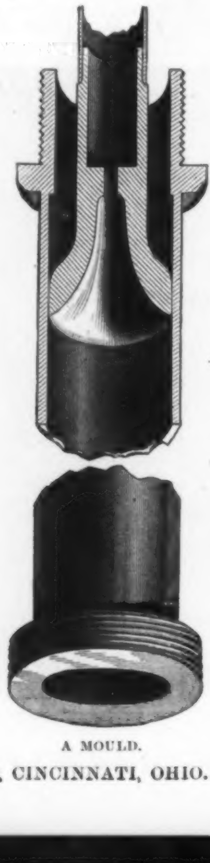
the liquid acids. If cooled rapidly or kept agitated while cooling, the acids become so intermingled that they cannot be separated by mechanical means, which at this stage of manufacture must replace the chemical, on the score of cheapness. If the fat is cooled very slowly, however, it has been found that the solid acids will crystallize, while the liquid acid, the oleic which it is desired to banish, will lie snugly ensconced between the crystals, to be afterward forced out by heavy pressure.

The cooling of the fat is a slow process. It is run into shallow pans, lined with enamel to prevent the acids from eating the metal, and permitted to remain in a warm room two or three days. These pans are arranged in sections, like alcoves in a library, one row of pans underneath the other, and each extending a slight distance alternately to front or rear beyond the one above it. The hot fat is conducted over the top of the alcove in a wooden chute, and the filling of all the pans down to the floor is accomplished by taking a plug from the chute immediately over the top pan. When this is full it overflows at the front end by means of the slight depression made at that end, and the overflow is caught by the pan below, and so on down to the bottom. When the fat is become hard it is a cake of a brown, greasy mass, not unlike unrefined maple sugar. The discoloration comes from the oleic acid, which permeates the whole cake and can be forced from between the crystals of the hard acids by pressure with the thumb. The cakes are wrapped in heavy woolen cloths, piled into hydraulic presses between iron plates, and the pressure applied. A dark oil gushes from the woolen, pours over the edges of the plates, and is caught up beneath the press to be used in soap making. The cakes have now been squeezed down to less than two-thirds of their original thickness, and the mass presents a yellowish-white appearance. By breaking it, its crystalline texture can still be seen despite the fact that the shape of the crystals has been ruined by the pressure it has undergone. They are still somewhat greasy to the touch, for in this first pressure only fifty per cent. of the oleic acid has been removed. They now succeed to a second pressure, this time in a horizontal press, and between hollow iron plates that are kept hot by steam. Still wrapped in the woolen cloths, they are suspended between the plates in bags of horsehair cloth, and a very heavy pressure is applied from the end. When the cakes issue from this process they are as white almost as snow, very hard and dry, and when broken into small particles have a flaky appearance. The mass is now almost pure stearic acid, and is ready to be moulded into star or adamantine candles. Without an exception, this single hot pressing is deemed by other manufacturers to be sufficient for their higher grades of candles, such as are used for mining, dining-room, or library, but Messrs. Procter & Gamble Co. have learned that by again breaking up the cakes, melting, panning, and pressing in the hot press, a much better candle is produced, better because there is no smoke, the light is whiter, and consequently much stronger, and the candles last longer. These are strong points, especially where the candles are to be used for mining or in a close room, or where a pure, soft, white light is desirable, such as at a dinner party or reception.

These are the scientific phases through which the stearic acid candle goes ; what follows it is simply the fruit of the inventive faculty of our day. The visitor emerges from dark basement rooms, where he has been moving between tubs and under pipes and chutes all dripping with liquid grease, into a room on the ground floor. Here there is light in plenty, and opening off one side is a vista of a room vast in extent, with a glass roof like a hothouse, with long rows of tables separated by narrow paths, on which, bolt upright, stand thousands of shapely candles undergoing a brief bleaching process by sunlight. One end of the first room is filled with vats in which the prepared candle fat is melted, purified, sometimes colored, and brought to the temperature requisite for moulding. Utility is here, of course, the guiding consideration, but the group of big and little tubs, with the men moving among them, is not without its picturesque element. Upon the edges, and hanging from the spouts at which the moulder fills his double-lipped can, the candle fat has hardened in fantastic shapes, with surfaces of ivory like smoothness and sheen. The floor of the room is covered with moulds. In these moulds there is little remaining of the group of tin tubes through which the domestic candle maker, who had got beyond dips a few years ago, laboriously drew her wicks, to fasten them below with a knot, and above by looping them over little sticks. The tubes are now fixed in a frame having troughs along the top, into which they all open. They end below with the shoulder of the candle, and the moulds for the tips are the upper ends of piston rods, which, by a rack and pinion, are forced upward through the tubes to expel the candles, and which, when at rest, fall snugly into the shoulders. These rods are hollow, and the wicks pass continuously through them from bobbins placed in the floor of the frame. Care is exercised to have the fat at a temperature just above the melting point, to heat the mould to receive it, and immediately to cool it rapidly by forcing around the tubes a blast of cold air, so that the fat shall not crystallize as it did in the panning. When the candles are hard, the surplus fat in the troughs is removed, and a few turns of the handle forces them upward out of the moulds and into a rack placed on top of the machine to receive them. The lower board of the receiving rack is slightly shifted, so that the edges of the openings through which the candles pass catch the shoulders of the candles, and prevent them from dropping back into the moulds with the piston rods. These rods in expelling the candles draw up with them wicks for the next pouring, and in falling back into position pull the wicks taut and into place through the middle of the tubes. The candles in the rack are left until the next mouldful is cold ; then the wicks are cut by passing a knife between the mould frame and the rack, and they are emptied into boxes, which are mounted on trucks, and pushed from mould to mould. Bleaching, polishing, stamping and packing are all that remain to be done. The first process takes place in the adjoining room already mentioned ; a few hours of sunlight bleaches the yellowish tinge out of the fat. Common grades are then rubbed with cloths and packed ; better grades are polished by a machine, into one end of which they are fed by one woman, while another packs them into boxes from the other. The process is very simple. A grooved cylinder receives the candles from the feeder, and after carrying them past a revolving saw, which cuts off the butts evenly, deposits them upon a bed plate between the rods of an endless frame with linked sides, kept in motion by cog wheels. Over this bed plate they roll under a revolving buffer, which gives them a vigorous brushing from end to end, and gives them the beautiful porcelain finish as they pass toward the end where they roll off into the packer's box. All grades are stamped with the name of the maker, and in some instances the trade name of the candle, "Composite," etc. This stamp is melted into them by a branding iron as they pass through a small machine, which, like the polisher, is fed by a grooved cylinder.



STAMPING.



A MOULD.

HOW CANDLES ARE MADE—MANUFACTORY OF PROCTER & GAMBLE, CINCINNATI, OHIO.

USES OF FISH SCALES.

The scales of fish are composed of alternate layers of membranous laminæ and phosphate of lime, to which they owe their brilliancy, and from which those of certain species derive their commercial value.

The perfectly white solution of the scales of the bleak (Leuciscus alburnus), a fish indigenous to the rivers of France, as well as those of other species of Cyprinidæ, is now largely used for the manufacture of artificial pearls ; and in our Science Notes of February 24 we called attention to the fact that our consul at Lyons has found that the supply is inadequate and that there is an actual demand for large quantities of scales in his consulate, where good prices are paid for them.

The solution ("Pearl White," "Essence d'Orient," or "Guanine") is a mucus that lubricates the scales of the fish. It coagulates by heat to a thick, white deposit, and is obtained by carefully scraping the fish over a tub containing fresh water. Care is taken not to scale the dorsal part of the fish under consideration, since the scales derived therefrom are yellow, while only the white ones possess value. The material is received on a horsehair sieve. The first water, mixed with a little blood, is rejected. The scales are then washed and pressed, and the essence sinks to the bottom of the tub and appears as a very brilliant blue-white oily mass. It takes 40,000 fish to furnish two pounds of material. The fishermen seal it in tin boxes with ammonia, and in this condition send it to Paris. If a drop of the essence be taken up by a straw and let fall upon water, it floats and gives forth the most brilliant colors. Glass bulbs, in the shape of pearls, lined with this substance, imitate the real gems with remarkable closeness.

Fish scales are also used for other industrial purposes. Some years ago we published the following note :

"Among the recent patents is that of Edward and Julius Heubner, of Newark, who have invented certain new and useful improvements in preparing fish scales for use in the arts, of which the following is a specification :

"The object of the invention is to utilize the scales of several varieties of fish hitherto thrown away as useless, and prepare them for application in the arts, by producing articles of jewelry, artificial flowers, and similar objects. This invention consists in the process of cleansing and purifying the scales till the clear, horny substance or core of the same is obtained, which produces a new article of manufacture, which may be stamped into various ornamental shapes and dyed in all colors, for use in the arts.

"Large scales are the most advantageous, taken from fresh fish. Old scales cannot be used, as they lack elasticity and clearness. The fish scales are exposed for twenty-four hours to the action of the pure salt

water, for loosening and partially separating the outer layers of organic matter. They are then transferred to distilled water, being placed every two or three hours in clean water and washed therein five or six times, which renders the scales soft and clear. Each scale is then carefully rubbed with clean linen rags, then passed through a press having a linen lining so as to remove the moisture in the scales. The scales are finally placed for one hour in alcohol and again rubbed and pressed. When they are dry they have a perfectly clear appearance, a mother-of-pearl-like hue, and great elasticity and durability.

"The scales are used in this prepared state, or they may be dyed with aniline and other colors, in the usual manner, to be stamped into various kinds of ornamental shapes, leaves and flowers, and applied to the manufacture of jewelry and artificial flowers, for embroidering and inlaying wood, and other uses in art."

In 1875, the Royal University of Norway, Christiania, sent to the Smithsonian Institution a diadem made from fish scales and eyes; and at the Paris International Exposition of 1878 two Swedish exhibitors showed flowers and ornaments made of fish scales.

At the Vienna International Exposition the scales of the captain fish (Heterotis), from Senegal, were shown for making fish glue to stiffen and glaze ribbons.

Fish-scale parures and ornaments for ladies were at one time largely sold at the Crystal Palace, London.

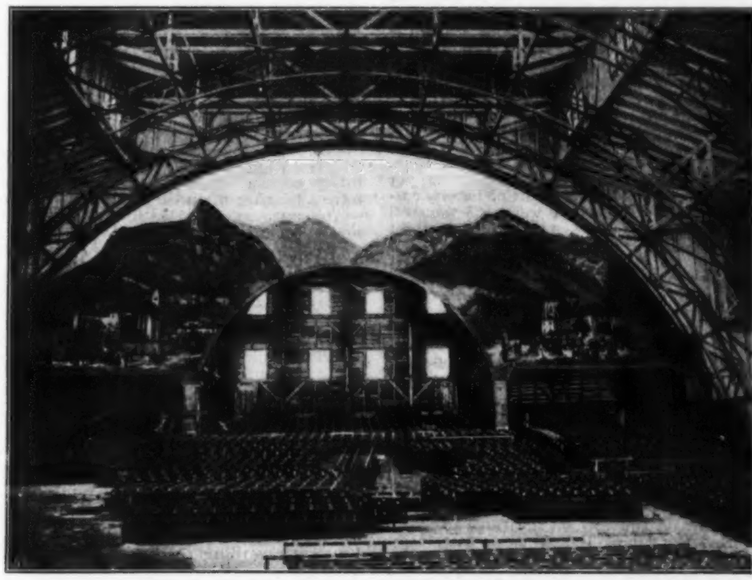
The Chinese have a method of grinding up fish scales and using the powder as a dry pigment to give a brilliancy to parts of pictures.

The scales of the American fish, the Tarpum, which Captain Dampier says are "as big as a half crown," are now largely used for ornamental purposes. Among other fish of which the scales are so employed are certain parrot fishes (Scaridæ and Labridæ), mullets, sheep's head, drum, bass, perches and herring. The scales of certain eels are said to be used in the north of Europe to give a pearly luster in ornamental house painting; those of garpikes were used by the Indians for arrow tips; and those of the sturgeon were employed by the colonists of what are now the Southern States as graters.

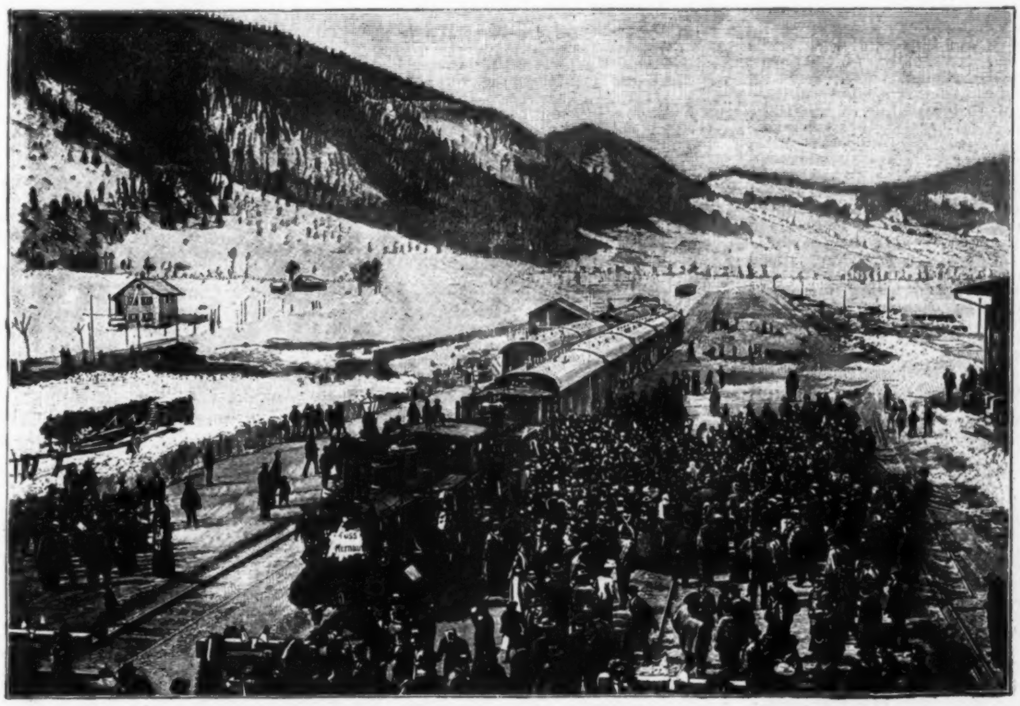
THE MURNAU-OBERAMMERGAU RAILROAD.

THE completion of the Murnau-Kohlgrub-Oberammergau Railroad is an event of great importance to those who may visit the Passion Play, as well as to the general public, however much it may be regretted by the drivers who formerly carried the numerous visitors to the playhouse, for it will make the journey to that well known mountain village, Oberammergau, much easier. The road was constructed by the Aktiengesellschaft Elektricitätswerke (formerly O. L. Kummer & Company) of Dresden, provision being made for the use of either steam or electricity, for although electricity will be sufficient for the local and freight business, steam will be required for the heavy traffic that must be arranged for at the time of the Passion Play. This is the first road in Germany to be operated by the rotating or polyphase current. The conductors are carried above ground. The line runs through beautiful country, offering a succession of fine views of the mountains. It covers a distance of about 15 miles and is provided with ten stations.

The rear wall of the great hall at Oberammergau has been decorated by a painting representing the village as it was at the time when the Passion Play was first given there, 1634. The Passion Play is given once each ten years. This is the work of the scene painter Mettenleitner, of Munich.—Ueber Land und Meer.



HALL AT OBERAMMERGAU WHERE THE PASSION PLAY IS GIVEN.



THE OPENING OF THE NEW RAILROAD FROM MURNAU TO OBERAMMERGAU.

CABLE ACCOUNT TO THE NEW YORK TRIBUNE OF THE FIRST PERFORMANCE OF THE PASSION PLAY THIS SEASON.

Oberammergau, May 20.—When the last scene of the last act of the Passion Play was ended, at a little before 6 o'clock, this afternoon, German critics who have observed former productions declared the performance in every detail, except the acting of Lang, superior to any of the others presented in the last half century.

The day passed off without serious incident. It rained all of Saturday night and early this morning, but increased a little after daybreak. When the sun rose it was not strong enough to dissipate the heavy mists that obscured the mountain tops or warm the valleys. The weather has been bad for more than two months. The few Americans who came yesterday and the day before are preparing to go. Fear of pneumonia is driving most of the foreigners away, and will keep them absent until the season is a little more advanced. Most of those who sat through the performance of to-day did so wrapped in overcoats. The air was chill and penetrating.

The performance to-day, while accessible to the public, was in reality a dress rehearsal given for the benefit of the press association of Germany, some eight hundred in number. In addition to the German papers a few other journals of the Continent had representatives present. There were four correspondents from St. Petersburg and two from the United States. One-fifth of the seats were occupied by members of the press. The others had been sold weeks before, and were occupied. So the theater was filled.

At 6 o'clock this morning hundreds of strangers attended early high mass. There was a chorus of one hundred voices. The services had not been ended before the village band began playing. That was the signal for all to go to the theater. The play began with a solo by the choragus, which was followed by a chorus of six hundred. Then the curtain rose on the first tableau, "Adam and Eve in the Garden." From that moment until 1 o'clock, when there was an intermission for rest and refreshments, the entire audience sat almost without motion, with eyes and ears strained to catch all that came to the senses.

There are nine hundred persons connected with the play—actors, attendants and ushers—all natives of the village. Some of the parts that characterized former performances were eliminated this time by order of the government, but they were minor ones, and were not conspicuous by their absence to former attendants. The most impressive and realistic scenes were the entrance of Jesus into Jerusalem, Jesus before Pilate and the Crucifixion. Lang, who played the part of the Redeemer, is not so good an actor as his predecessor, Mayer. Mayer was on the stage in the prologue. Lang's voice is not musical, nor are his gestures and movements as graceful as those of Mayer. He is too boyish looking. As he stood before Pilate he came near fainting away. A nervous tremor took possession of his body and perspiration streamed from his face. Mayer was near him much of the time, and his coaching probably saved him from collapse.

Miss Anna Flunger, as the Virgin Mary, captivated the critics. She is little more than a child, and though it was her first appearance before a big audience, she went through her part with confidence. Miss Flunger's voice is strong, yet soft.

The Crucifixion scene was intensely dramatic, but the lines of agony on Lang's face were too severe. In some of the tableaus representing incidents described in the Old Testament it becomes necessary for some of the figures to remain absolutely still for minutes. This is trying, but it was well done to-day. Mayer's elocutionary powers had fine scope in his recital of the prologue.

Improvement in the Production of Celluloid.—The "Société general pour la fabrication des matières plastiques" has taken up an improvement in the process of making celluloid. The object is to effect a considerably greater strength and an easier working of the material. The composition employed by the company consists of a mixture of pyroxylin, camphor, alcohol (as solvent), and castor oil, which latter causes the flexibility, and to this is finally added a certain quantity of naphthalin, whose intense odor quickly evaporates from the product in the air.—Technische Berichte.

STEEL CROSSTIES IN SUMATRA.

THE discovery of rich coal deposits in the mountainous interior of the island of Sumatra, in the Dutch East Indies, in 1887, started the railroad from the port of Emma, in the neighborhood of the city of Padang, to the Barisan Mountains. At present 210 kilometers of the railroad is in operation, 36 kilometers of the rack (Riggenbach) and 174 kilometers of the ordinary adhesion system. The gage of this railroad (which is the property of and exploited by the Netherlands government) is 1·067 meters, the same gage as the Netherlands State Railroad on the island of Java. The greatest grade on the ordinary lines is 1 in 43·5, and on the rack line 1 in 12·5, while the sharpest curve is 150 meters radius. The railroad rises 1154 meters above the level of the sea.

The rails weigh 25·7 kilogrammes per meter and are laid on steel sleepers weighing 39 kilogrammes (system Post). On the common track lines eight sleepers, and on the rack lines nine sleepers are provided for each rail length of seven meters. The total superstructure, including fastenings, weighs 105 kilogrammes on the adhesion and 187 kilogrammes per meter on rack lines. In a tunnel 825 meters long, rails of 40 kilogrammes per meter have been employed on account of loss by corrosion. The heaviest locomotives weigh 35 tons, 9·3 tons resting on each of the three coupled axles, and 7·1 tons on the driving axle. The greatest speed is 30 kilometers per hour.

The best timber available in the colony for crossties is the djatti wood, a kind of teak, similar in its qualities to oak. Under the influence of the climate, wooden ties would not last more than 8 or 10 years. The steel sleepers employed, however, as shown by close examination made in the spring of 1899 on the 60 kilometers long line Emma Port-Kaiutanam—after having been used for 9½ years and run over on the different lines by from 31,200 to 104,000 trains—were found to be in a very good condition. A close examination made of 11 ties taken from the track at different points showed an average decrease in weight of 100 grammes, caused by wear and rust, or about ⅓ per cent. of the original weight per year. Of a few sleepers exposed to humidity, the decrease in weight was found to be a trifle greater. The wear on the top of the rails at points where the rails were fastened was, in most cases, insignificant; on a few other crossties, taken from places where especially unfavorable influences prevailed, the wear amounted to three millimeters below the exterior part of the rail foot.

The engineer-in-chief of the line thinks that, by the adoption of plates, this unfavorable influence of the exterior edges of the rail could be avoided, or at least decreased to a large extent. The wear of the bolt holes was unimportant.

The gage was, on the whole, well preserved. Only in the curves of 150 and 200 meters radius some defects of gage of from 9 to 12 millimeters were found resulting from the wear of bolts and bolt holes. In order to avoid this it is proposed to increase the number of sleepers by one or two per rail length.

A calculation of the cost of the wooden and steel sleepers showed that the latter are cheaper, if they remain in good condition for 19 years. From the condition of the steel sleepers after 9½ years, it may be asserted that the average lifetime of steel sleepers considerably exceeds 19 years.—The Railroad Gazette.

ALINITE.

THE preparation known under the name of alinite is a yellowish powder containing a pure culture of Caron's Bacillus Ellenbachensis alpha. This bacillus has the property of assimilating atmospheric nitrogen, and thus renders the use of nitrated manures for the culture of cereals more or less superfluous.

Stoklasa has shown that this bacillus is a denitrifying one and that it decomposes fibrine, making 22 per cent. of its nitrogen soluble after seventy-six days; while in another experiment, without inoculation, only 4 per cent. of the nitrogen passed to the soluble state. Analogous experiments with peat show that in seventy-two days 42 per cent. of the nitrogen passed into the soluble state under the influence of this microbe. Finally, experiments made with barley showed that fixation of free nitrogen took place in the presence of alinite.

Stoklasa, however, came to the conclusion that the principal work of the bacillus consisted in the transformation of the nitrogen of the organic matter in the soil into assimilable nitrogen.

Stutzer and Hartleb concluded that the bacillus is aërobic, that is to say, very similar to the B. Mycoides and the B. Megatherium, and that in its manner of behavior with nitrated substances it resembles the bacteria of putrefaction.

According to Lauck, alinite would be a pure culture of the Bacillus subtilis Ehrenberg, developed in a special preparation of powdered potato. He found that this bacillus has the property of liquefying the albumen of a boiled egg. A culture of this bacillus, to which was added some peptone, soon gave off the characteristic smell of tri-methylamine.

As to the practical use of alinite, Caron states that according to his experiments the use of this substance increases the crops. On the other hand, Moercker shows it to be absolutely inefficient.

A large number of experiments have been carried out in the open field, but the results have been very contradictory.—Biedermann's Centralblatt, 1899, xxviii., 156.

Technische Berichte reports the following regarding a new kind of tree for the production of gutta-percha: "Gutta-percha has so far been obtained almost exclusively from trees in Dutch India, and attempts to plant these trees in French colonies have yielded but little satisfying results. The conditions for a lucrative growing of the rubber trees of Java are such that their cultivation can only be carried on in few colonies. For this reason the discovery of a rubber tree which affords the advantage of being easily transplanted is of eminent importance. The new plant is derived from North China and is called Eucomia illinoides. Its fruit is said to contain 27 to 34 per cent. of gutta-percha of excellent quality. In the Colonial Garden at Paris, a specimen of this kind has been grown with good success."

TRADE NOTES AND RECEIPTS.

Ink Spots are removed from damask by sprinkling very fine cooking salt or sorrel salt over the stain, moistening it well with lemon juice and allowing to dry. This process is repeated once more, and when the spot is dry, it is treated with common curd soap without wetting the soap, and the whole piece is washed out very thoroughly like other wash.—Intern. Wäsche Zeitung.

Ammon's Must Substance consists of the following:

I. Acid tartaric, natr. chlorat., aa 500 grammes; chicory, tartarus crudus, aa 1,000 grammes; 375 grammes of this mixture per 150 liters.

II. Spirit. aether. nitr., pear ether, aa 5 grammes; 10 grammes per 150 liters.

III. Tamarinds 300 grammes, sugar from 10–12 kilos; 5 kilos per 150 liters.—Zeitschrift für öst. Pharm.

As Regards their Manurial Value, oil cakes take the following diminishing rotation, according to L. Malpeaux: Sesame, poppy, earth-nut, egg, niger, rape, castor, raisins, cotton-seed, and palm-kernel cakes. This rotation, however, cannot be regarded as absolutely correct, since too many secondary conditions have a bearing upon the fertilizing effect of the cakes.—Ann. agronom., 25, 111, through Zeitschrift für angewandte Chemie.

Strengthening Filter Paper.—A process to increase the resistance of filtering paper is described as follows: The process consists in dipping the paper in nitric acid of 1·433 specific gravity, subsequently washing it well and drying it. The paper thereby acquires highly advantageous qualities. It shrinks a little and loses in weight, while on burning only a small quantity of ashes remains. It possesses no traces of nitrogen and does not in any way attack the liquid to be filtered. Withal, this paper remains perfectly pervious for the most varying liquids, and its filtering capacity is in no wise impaired. It is difficult to tear and still elastic and flexible like linen. It is obvious that these qualities make the paper appear very advantageous, especially for filtration with pressure. It clings completely to the funnel. In general it may be said that the strength of the filtering paper thus treated increases 100 per cent. This fact has been established by tests regarding the resistance to tensile strain.—Technische Berichte.

Fat Face Paints for the Stage.—

White.—Calc. carbonic, zinc oxyd., bism. sub-nitric, alum plumosi, aa 8·0 grammes, are made into a paste with about 3·0 grammes of almond oil, next mixed with ol. menth. pip., camphoræ, aa 0·2 gramme, and scented with 1·0 gramme of ess. bouquet.

Pale Red.—Zinc oxydat., bism. subnitr., alum plumosi, aa 10·0 grammes, eosini 0·04 gramme dissolved in 1 gramme ess. bouquet, ol. menth. pip., camphoræ, aa 0·2 gramme, ol. amygdalar. q.s. (4 grammes).

Deep Red.—Zinc oxydat., bism. subnitr., alum plumosi, aa 15·0 grammes, camph. ol. menth. pip., aa 0·2 gramme, carmine 0·5 (dissolved in 20 drops of NH_3), ess. bouquet 1·5 gramme, ol. amygdalar. q. s. (5·5 grammes).

Flesh Tint.—Cinnabaris subt. plv. 3·0, tinct. croci 2·0, rhizom. irid. plv. 5·0, calc. carbonic, zinc oxydat., aa 20·0, ol. menth. pip., camphoræ, aa 0·3 gramme, ol. amygdalar., q. s. (6 grammes), ess. bouquet 1·5 gramme.

Black.—Finely grind fuliginis (finest grade), 2 grms., with ol. amygdalar. 2 grms., and carefully mix with 6 grms. of melted ol. cacao. Scent and shape or pour into sticks.—Pharmaceutische Zeitung.

New Process of Refining Mineral Oils.—The refining of mineral oils is generally accomplished by mixing liquid sulphuric acid with the oil and bringing about an intimate contact of both liquids by stirring and blowing in air. This process, however, labors under the disadvantage that hardly 20–25 per cent. of the acid employed can be turned to account.

The resulting waste contains the high percentage of 70–80 per cent. H_2SO_4, and is useless or partly so owing to the tar products contained therein, which do not separate. It constitutes a plague in the refineries, acidifying all the drains, and causing considerable cost and trouble.

The present new process minimizes these calamities and renders possible a rational purification of the oils with little expenditure of acid.

For this purpose fuming sulphuric acid with as high a percentage of anhydrous sulphuric acid as possible is employed. When air is blown through same, it departs, charged with anhydrite-steam, and is in this stage the most suitable agent for the refining of oils.

Blown into the oil through a spraying contrivance or a perforated tube, the acid gets into the oil in an ideal distribution and with the highest action capacity, namely as anhydrate, and is completely absorbed if the oil layer is sufficiently high. The simultaneous air pressure effects an intimate mixing and the arrangement admits of conducting the refining to any stage and to interrupt it as required.

The introduction of the method into existing plants presents no difficulties. Air pumps are present in all large refineries and an agitator can be suitably mounted anywhere. Between air pumps and agitator an iron vessel in the shape of a Wulff flask is inserted as an acid receptacle. The compressed air is blown through the acid.

Further arrangements are:

1. Distribution of the acid-charged air in bubbles of the smallest possible size so as to facilitate its absorption.

2. Previous drying of the air blown into the oil, so as not to unnecessarily dilute the oleum. For this purpose the blown-out acid may be used with advantage, which may finally be utilized, at acceptable prices, for most industrial applications, such as manure acid, etc.

3. A warm water bath of the acid vessel, so as to keep the oleum liquid.

In case of new installations or reconstructions, it is advisable to mount several agitation vessels, step-like, over one another, and the acid vapors are pressed over from one vessel into the other. This allows of a continuous working and the sulphuric acid may finally be utilized by working it into sulphite, etc. Washing and deacidification are then conducted in the ordinary manner.—Seifensieder Zeitung, Augsburg.

SELECTED FORMULÆ.

The Care of the Teeth.—

MOUTH WASHES.

Orris and Rose.

Orris root	120 grms.
Rose leaves	30 "
Soap bark	30 "
Cochineal	15 "
Diluted alcohol	1,900 c. c.
Oil rose	30 drops.
Oil neroli	40 "

Myrrh Astringent.

Tincture myrrh	500 c. c.
Tincture benzoin	200 "
Tincture cinchona	30 "
Alcohol	900 "
Oil of rose	30 drops.

Borotonic.

Acid boric	20 grms.
Oil wintergreen	10 "
Glycerin	110 c. c.
Alcohol	150 "
Distilled water, enough to make	600 "

Sweet Salicyl.

Acid salicylic	4·0 grms.
Saccharin	1·0 "
Sodium bicarbonate	1·0 "
Alcohol	200·0 "

Foaming Orange.

Castile soap	95 grms.
Oil orange	10 drops.
Oil cinnamon	5 "
Distilled water	120 c. c.
Alcohol	360 "

Australian Mint.

Thymol	0·25 grms.
Acid benzoic	3·00 "
Tincture eucalyptus	15·00 "
Alcohol	100·00 c. c.
Oil peppermint	0·75 "

Fragrant Dentine.

Soap bark	125 grms.
Glycerin	95 c. c.
Alcohol	155 "
Rose water	450 "

Macerate for four days and add:

Carbolic acid, cryst	4·0 grms.
Oil geranium	0·6 c. c.
Oil cloves	0·6 "
Oil rose	0·6 "
Oil cinnamon	0·6 "
Tincture rhatany	45·0 "
Rose water	450·0 "

Allow to stand four days; then filter.

Aromantiseptic.

Thymol	20·0
Oil peppermint	10·0
Oil cloves	5·0
Oil sage	5·0
Oil marjoram	3·0
Oil sassafras	3·0
Oil wintergreen	0·5
Cumarin	0·5
Diluted alcohol	1000·0

The products of the foregoing formulas are used in the proportion of one teaspoonful in a half-glassful of water.

Foaming.

Soap bark powder	2 ozs.
Cochineal powder	60 grns.
Glycerin	3 ozs.
Alcohol	10 "
Water sufficient to make	32 "

Mix the soap, cochineal, glycerin, alcohol, and water together; let macerate for several days; filter and flavor; if same produces turbidity, shake up the mixture with magnesium carbonate and filter through paper.

Odonter.

Soap bark, powder	2 ozs.
Cudbear, powder	4 drms.
Glycerin	4 ozs.
Alcohol	14 "
Water sufficient to make	32 "

Mix, and let macerate, with frequent agitation, for several days; filter; add flavor; if necessary filter again through magnesium carbonate or paper pulp.

Sweet Anise.

Soap bark	2 ozs.
Anise seed	4 drms.
Cloves	4 "
Cinnamon	4 "
Cochineal	60 grns.
Vanilla	60 "
Oil of peppermint	1 drm.
Alcohol	16 ozs.
Water sufficient to make	32 "

Reduce the drugs to coarse powder, dissolve the oil of peppermint in the alcohol, add equal parts of water, and macerate therein the powders for 5 to 6 days, with frequent agitation; place in percolator and percolate until 32 fluid ounces have been obtained. Let stand for a week and filter through paper; if necessary to make it perfectly bright and clear shake up with some magnesia, and again filter.

Saponaceous.

White castile soap	2 ozs.
Glycerin	2 "
Alcohol	8 "
Water	4 "
Oil peppermint	20 drops.
Oil wintergreen	30 "
Solution of carmine N. F. sufficient to color.	

Dissolve the soap in the alcohol and water, add the other ingredients, and filter.—American Druggist.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Waterproof Material in Germany.—Under date of January 4, I sent a report on fireproof material, says E. Theophilus Liefeld, Consul at Freiburg, the invention of a firm in Freiburg, and incidentally made mention of the fact that the firm had been in existence for several years as manufacturers of waterproof articles, such as horse blankets, tenting, etc. As numerous inquiries have been received from the United States, indicating an active interest in this subject, I have investigated this other branch of industry and present the following report:

Until quite recently, no process of rendering woven fabric, canvas, etc., waterproof was known in Germany, except the use of fatty substances, such as wax, soap, paraffin, etc. A system had been invented in England of impregnation with a copper solution, but this did not prove entirely satisfactory; and, besides, as the process was kept a close secret, the raw material had to be shipped to England for treatment, which, of course, increased the price of the waterproof-finished product considerably and proved a great drawback. Experiments were then made in Germany, and a preparation of copper ammonium oxide was used by some firms; but this firm at Freiburg makes use of a solution containing zinc, copper, and ammonium hydrate, which has been patented in many countries, and goods treated with this preparation seem to have special advantages in respect to quality and color.

The copper in the solution, it seems, gives a beautiful blue-green color without the use of any dyestuffs whatsoever, the various shades being due to the differing qualities of the goods. Unbleached white cottons receive a bluish-green color, while the heavy canvas, which contains flax or hemp, becomes intensely green.

During impregnation, there is a chemical compound formed between the fiber of the fabric and the solution, so it is clear that the new properties must become firmly fixed. It will also be evident from this fact that there can be no clogging of the fabric with various salts; and, what is of still more importance, the weight remains almost unchanged.

The copper in the solution, it is claimed, will prevent the growth of destructive germs, and the material itself becomes incorruptible and very serviceable for all kinds of weather. Goods which have been buried or kept underground for a long time are unaffected, while the corresponding raw material, or that treated with a non-metallic solution, if kept underground the same length of time, would show signs of decay and decomposition and lose the power of resistance.

As no fatty substances are contained in this solution, the fabric treated is not liable to be attacked by insects and worms.

On account of the advantages of light weight, resistance to decomposition, protection against insects, etc., the material is well adapted for tenting, especially in tropical regions; and I understand that the German army administration is making free use of these goods for field hospitals, horse blankets, awnings, etc.

By dyeing the material before impregnation, other colors can be obtained, as olive green, brown, and black, and in every case the qualities remain good.

Thin cotton goods are used for the manufacture of waterproof garments for hunters, physicians, and coachmen, who have to be out in all kinds of weather, and also for gossamers and bicycle garments.

Not only are these substances very light, but they have the great advantage of cheapness, are odorless, do not break or become sticky, and are preferable to articles made of rubber, as they do not prevent the free circulation of the air.

Railway Improvements in Prince Edward Island.—The Prince Edward Island Railway is a narrow-gauge road, 210 miles in length, traversing the island from end to end. Its general offices are at Charlottetown.

A branch is to be built to the Murray Harbor district, in the southern part of the Province. The extension will be 75 miles in length. The southern end will have a deep-water terminus for the shipping of produce to the iron mines at Sydney, Nova Scotia; also to Boston.

This addition will pass through one of the best farming districts of the island, and will tend to open a very fine country for tourists.

The building of this extension will necessitate the construction of a bridge across the Hillsborough River near Charlottetown, the distance being three-fourths of a mile. This bridge is to be built with nine stone piers and steel superstructure, for the convenience of a railway and carriage bridge. The estimated cost is $1,000,000. I am informed that tenders for the building of the bridge will be called for within three months.—Delmar J. Vail, Consul at Charlottetown.

Maple Sugar Industry in Quebec.—The season varies in length from ten days to three weeks, and occurs between the 10th of March and the 20th of April. It is a period of exceptional activity, and every available member of the family is pressed into service, district schools being closed. Sugar "bushes" contain from 400 to 5,000 trees. Five thousand are rare, 2,000 not uncommon; but the average "bush" contains from 1,000 to 1,500 trees, which yield from 1 to 4 pounds of sugar per tree during the season. Two and one half pounds are considered an average yield, 3 pounds good, and 4 pounds per tree exceptional. Almost every farmer in eastern Quebec is a sugar manufacturer to the extent of from 500 to 15,000 pounds a year, or from one-fourth of a ton to 7½ tons.

There are no available data from which to make anything like an accurate estimate of the maple sugar production of Canada, but from the facts already set forth, it will be seen at once to be of considerable importance. It is, of course, well known that a great portion of the maple sap is never reduced to sugar, but is finished as sirup; yet the yield is always estimated in pounds of sugar, a gallon of sirup being equivalent to 7 pounds of sugar.

The "tapping" of 2,000 or 3,000 trees, the insertion of spouts, and the hanging of sap buckets is very quickly accomplished by the experienced sugar makers, one man tapping from 500 to 600 trees a day. The gathering of the sap is a much more serious matter. When the "run" is on, each tree has to be visited twice a day and the buckets emptied, their contents being received by a huge barrel drawn on a sled, hauled to the sugar camp, and transferred to a large tank, from which the sap is drawn off into the evaporator. From this it emerges as sirup; and if sugar be desired, it is passed into another pan where the "sugaring off" is completed.

By a system of cross sections in the evaporating pan, with apertures alternating at either end, the sap is forced slowly along a zigzag course down the whole length of the pan from the receiving compartment, where it is thoroughly strained, to the finishing compartment, whence it is drawn off through a faucet. When the sap boils too furiously, a few drops of milk act like magic in subduing it.

The skilled sugar maker can easily tell the proper consistency for sirup or sugar, but this is more accurately gauged by a hydrometer which indicates the specific gravity of the liquid. The sugar molds for 1½ pound cakes consist of a few parallel wooden bars connected by movable transverse iron sections, from which the cakes may easily be removed.—Felix S. S. Johnson, Commercial Agent at Stanbridge.

New Method of Making Limestone Brick.—Burnt clay bricks, like natural stone, have served as building material from the beginning of history, among nearly all races. Recently, a formidable rival has sprung up in the sandstone brick. This brick is the product of quartziferous sand, with which a proportionately small amount of lime is mixed, the whole mass being subjected to a high pressure of steam. The result is an extremely hard, water tight product, impervious to frost or weather and unaffected by all acids. Like every new industry, sandstone brick making has had many technical difficulties to overcome, the principal one being caused by changes in the weather. In cold, wet weather much poorer results have been obtained than in warm, fine weather. Chemists and experts have tried to find a way by which a uniform degree of excellency would be insured; but all failed, until the Zurich chemist Wilhelm Schwarz invented a process by which good results could be obtained under all circumstances. Mr. Schwarz found that it was necessary to give the mixture an exact quantity of moisture, as well as to prepare and mix it at a certain temperature, so that the combination of the silicic acid in the sand and lime should begin of take place before the mixture is pressed into brick forms. In this way, all deleterious aeration of the lime is avoided during the manufacturing process. Mr. Schwarz has invented a process by which the amount of moisture can be regulated—namely, mixing dry sand with lime in a vacuum, so that any aeration of the lime by the carbonic acid of the atmosphere is impossible. At the same time, the temperature is raised to and kept at a certain degree by steam heat, and then a certain quantity of moisture in the form of steam is admitted. By this means, the preparatory process is safely finished, the action of the steam causing the condensation of the silicic acid in the sand and lime and so giving the proper proportion of cementing particles to the mixture.

For employing this process, a machine has been built in which the preparatory and working process can be carried out—a mixing machine provided with revolving arms for mixing the sand and lime, steam tight, with an air pump attached to exhaust the air and also to draw out any excessive quantity of moisture. Inside is a tube for admitting the exact quantity of necessary steam. By properly managing three valves, the limestone raw product can be made of uniform quality, while formerly several machines and apparatus, which needed constant attention, were necessary for making this product, and then the results were never entirely satisfactory.

With the Schwarz invention begins a new era in the limestone brick industry that will be of great importance in all countries, and particularly in regions where there is neither clay nor stone, but where there is plenty of sand.—Brainard H. Warner, Jr., Consul at Leipzig.

Liquid Fuel in Europe.—The scarcity and high price of coal have given much impetus to the construction of apparatus for using liquid fuel, petroleum, benzine, and gasoline, and competent authorities are sanguine of success. The advantages of liquid fuel, when properly applied, are obvious. There is no smoke, no stoking, no ashes or cinders, no incomplete combustion; the fire can be started or shut off at a moment's notice; a more even temperature can be maintained than by the use of coal or wood, and the fire can be regulated by the mere turning of a single cock. There is no dust or dirt, no spacious coal sheds are required, and there is no danger of spontaneous combustion, as frequently happens with coal.

It is claimed that petroleum and its manufactures will soon, to a great extent, supersede the use of coal for manufacturing purposes, and therefore the supply of petroleum becomes of great importance. Statistics show that the United States and Russia are between them producing, in round numbers, 120,000,000 barrels per year, and that the production of outside countries has of late increased so much that they are able to contribute enough now to bring the world's aggregate annual production to about 150,000,000 barrels. It is well known that the production of Russia is much less now than it might be, owing to the lack of enterprise of the people and to inadequate transportation facilities, which cause the price to be higher even in Germany, adjoining Russia, than that of American petroleum, which has to travel thousands of miles.

What is true of Russia is even more true of Asiatic countries, like Persia. The increased demand will stimulate the exploitation of oil fields in the different lands. Railway companies are trying oil-fired locomotives; one steamship line has adopted oil for firing under the boilers of most of its vessels. When oil was first burned under the boilers, it was introduced through an open trough or gutter, or placed in the furnace in bowls. A new system is now employed and is gaining in favor, whereby the oil is evaporated by being mixed with hot air. This is said to be an improvement on the method of employing a steam jet. Nothing seems to be in the way of a more extensive use of oil for fuel, except the price.

Benzine and gasoline are used to furnish motive power for many different purposes, and their use is constantly increasing. A benzine-worked locomotive, constructed at the Deutz Gasmotor Works, near Cologne, has been running in the third level of the Laurahütte colliery, in the Kattowitz coal district, for over a year. With the exception of a slight derangement, which was readily repaired, the locomotive has performed its work satisfactorily and without interruption. The locomotive weighs 4,600 pounds; the length is 9 feet 2 inches; width, 2 feet 11 inches; height from rail level, 1 foot 4 inches; and gauge, 1 foot 8 inches. It has 6 horse power. The actual work performed by the locomotive is the hauling in one trip of from thirteen to fourteen buckets loaded with ore, weighing about 1,375 pounds, or about 120 metric tons per shift. To do this, the consumption of benzine is about 22 pounds and the daily expenses, including interest on investment and sinking fund, wages of engine driver, benzine and lubricants, are $1.80; so that the cost of hauling 1 metric ton (2,200 pounds) is 1½ cents, against 2⅔ cents with horses. As the engine is closed on all sides, so that the driver can only get at the interior by using a key, the danger of explosion is practically obviated. No inconvenience from the odor emitted has been experienced by the miners working in the level.—Richard Guenther, Consul-General at Frankfort.

Under date of March 27, Mr. Guenther adds:

I notice in St. Petersburg dispatches that the Russian government is considering a new mode for leasing oil lands owned by the Crown in the district of Baku, in order to reduce the price of coal oil, which within the last few years has been raised exorbitantly. It is proposed that after 1900, the lessees shall pay to the government 40 per cent. of the oil produced "in natura," so that the government can become a competitor in the sale of the article. Heretofore, the lessees paid a certain tax in cash on every pound of oil.

Condensed Milk in Chile.—Consul Warner writes from Leipzig, April 7, 1900:

The following is the substance of an article which recently appeared in the Leipziger Tageblatt:

The amount of condensed milk imported into Chile averages about 620,000 pounds annually, most of which is furnished by Great Britain and Germany. The milk is packed in cans, 4 dozen cans to a box, each can weighing a fraction over a pound. The condensed milk imported from England is designated and known to the trade as "English," while that from Germany is known as "Swiss."

Here is another product which England and Germany are exporting to Chile, the United States being in no way a competitor. Why is it that these two countries can sell their products in the markets of Chile, which is so much nearer our own country in point of distance? The question is easily answered: Their commercial marine gives them this advantage over us. When the day comes—and it is to be hoped that it is not far off—that our country will have a merchant marine, Chile will buy not only our condensed milk, but our iron, our machinery, our woolen and cotton goods, which she purchases to-day largely from England and Germany.

Proposed Railway in Honduras: Trade Notes.—Consul Johnston, of Utilla, under date of April 10, 1900, says:

There is a plan to build a railroad from Truxillo up the Roman River to Jutigalpa in Olaxcho State. This will open up a large valley, said to be unsurpassed for the cultivation of bananas; it will also touch large mahogany forests and the mineral lands of the interior of Honduras.

Exports are increasing as a result of the recovery of Bay Island from the storm in 1898. The first cargo of fruit shipped from that island since the storm was sent last month. The island of Ruatan is still short of fruit.

The imports are not so large as heretofore, because the people did not have the means to purchase; but the imports are nearly all—probably 90 per cent.—from the United States.

Match Factory Near Mannheim.—Consul Harris, of Mannheim, under date of March 20, 1900, reports the erection of a large manufacturing plant by the Diamond Match Company at Rheinau, a suburb of Mannheim. The buildings, which are wholly of brick, stone, glass, and metal (no wood being used for floors, sash, or other parts), are nearly completed. The latest improved machinery will be used. The concern will have a capacity of about 60,000,000 matches per day. About 7,500 feet of lumber will be required daily to run the plant to its full capacity. It is expected that 200 employees will be required. The plant is now in charge of Mr. T. F. Cleveland, of Akron, Ohio. The company is erecting a plant in Switzerland and has one in operation at Liverpool.

Phonographs in Spain.—Consul-General Bartleman writes from Malaga, April 3, 1900, in regard to the present Spanish tariff on phonographs. Mr. Bartleman has been instrumental in introducing into that city several of the Edison phonographs of all sizes, but with the existing tariff, the importation is impossible. Formerly, phonographs and accessories paid 30 pesetas maximum and 25 pesetas minimum duty per 100 kilograms, net weight; now they pay 8 pesetas and 5 pesetas per kilogram, net weight, according to the country of origin. A very large business in phonographs could be done were the present tariff reduced.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of [illegible] Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

MINERAL RESOURCES OF ECUADOR.

MINING in South American countries is attended with many disadvantages, but the inducements held out are often sufficiently tempting, especially to those of adventurous spirit. One serious drawback is lack of information regarding the prospective fields. This objection is met in the case of Ecuador, at least, by the United States consul at Guayaquil, who has forwarded to the government at Washington an elaborate report on the minerals and mining in Ecuador, the data for which was furnished by Mr. C. VanIsschot, an eminent French metallurgist familiar with that country and its resources.

There are other serious drawbacks to mining in South American countries, including remoteness from world centers, distance from avenues of communication, bad roads, lack of capital, unscientific effort, lack of experience and extravagant management. Not the least serious obstacle is the fact that the public has been the victim of promoters. Better times and profitable investments are almost certain, but they must come from abroad. Nearly all enterprises in every South American country are conducted by Europeans or Americans.

The mines of Ecuador have long attracted attention. As early as 1549, the Spaniards began to work the rich mineral veins found near Zaruma, in the province of Del Oro, and they are to-day worked by an American company. The placer mines near the rivers Santiago, Uimbi and Cachabi, in the province of Esmeraldas, were also early exploited; but these were all abandoned when slavery was abolished. The most attractive field thus far discovered is that of Zaruma and the provinces southeast of Guayas.

A report on the Zaruma district in 1876 by Dr. Wolf led to the formation of several companies, but none of them survived. Afterward the South American Development Company of New York was formed and is now actively and successfully mining. The same can be said of the National, a small native company. The district is about 60 miles from the coast and is reached by very bad roads, or mountain trails, which make transportation slow, difficult and expensive, especially during the rainy season, when the road is a mere bog. This is the most serious drawback, work being frequently retarded thereby. The mining in Zaruma district is principally by drifts, and the mines are self-draining. There are also placer mines in the district, but they have received little attention,

Placer mines of Esmeraldas were worked under the Spaniards by slaves, afterward abandoned, and, like Zaruma, are at present in the hands of an American company. Results have been disappointing thus far, but recent improvements in water supply and a change of management warrant hopes of future success.

Platinum is found in the washings of Esmeraldas in variable quantities.

There is little data regarding silver. If any mines were worked during the period of Spanish occupation their locality has been lost. The ores exist in porphyritic formations, but they are hard to trace by reason of being either abandoned or buried; a few are known.

Deposits of copper are found in the province of Loja at Catacocha; but bad roads and remoteness preclude development. Others have been recently discovered in the province of Azuay, 35 miles from the coast, at an altitude of about 5,000 feet. These deposits are believed to possess great value and are now being developed. All conditions are favorable as regards location, fuel, water, labor, etc. It is believed that this is the most valuable mineral deposit in Ecuador, and the owners are sanguine of realizing for themselves and future associates a fortune from their find. The copper mines of Peru in the Cerro de Pasco district, 320 miles from the coast and 100 miles from the Oroya Railroad, are paying, despite the enormous cost involved in transportation.

No quicksilver mines are known to exist; but mercury in a metallic state has been found in various localities, even in the suburbs of Guayaquil on the hill Santa Ana. M. VanIsschot found it in Los Rios; on the banks of the Collaya, in the Eastern Cordillera; on the Esmeraldas; and in the cultivated valleys of Cuenca and Azogues; but the source of the formation is unknown. The mercury is in too minute quantities to be workable, although found in a free state.

Petroleum was first noticed in the last century by Velasco, a priest who found the natives using it after its reduction to pitch. Deposits are found on the shores of the Pacific. In many places, in strata of schist, signs of bituminous substances are visible. The field, which seems quite rich, stretches horizontally and is of variable thickness. At a depth of 3 or 4 feet the earth is found of dark brown gray, like a sponge, saturated with salt water and petroleum.

Anthracite is found in the crystalline schist of Penipe, near Riobamba; lignite, in the neighborhood of Azogues, Loja, and Malacatos in strata of tertiary formation. All are in the interior, and valueless until reached by railroads.

Salt is obtained by the natives for domestic consumption, and rich strata of sulphur mixed with sand are also found. In 1874 a well was sunk by order of Garcia Moreno, then president, but was not driven to a sufficient depth to show results. The government has reserved for national benefit the parish of Santa Elena and will invite bidders. Gypsum is found in the same formation.

Despite her ample deposits, Ecuador is at the bottom of the list of South American republics in gold production, largely on account of lack of roads. The Engineering and Mining Journal places the amount produced in 1897 and 1898 at only 199·9 kilogrammes (440·7 pounds); but this is erroneous, as a portion is used locally and more leaves the republic by way of Colombia. From June to October, 1899, the South American Development Company exported about $36,000 worth; they are now shipping about $7,500 per month. It is believed that this product will soon be doubled or trebled.

Under act of 1892, properties can be acquired by natives or foreigners by simple "denouncement" (pre-emption) before the local authorities. Claims can cover 600 meters (1,968½ feet) in length by 200 meters (656 feet) in width; for placer mines and coal fields, 50,000 square meters (12,355 acres). Twenty claims can be pre-empted by the same person. Possession is indefinite as to time if $25 annual tax is paid on claims worked and $8 on those not worked. Machinery and all mining supplies are exempt from customs duties, nor are any fiscal duties charged on concessions or sales. —Modern Machinery.

THE ART OF THE PARIS EXPOSITION AND SOME OF ITS BUILDINGS.

FROM whatever point of view it is regarded, the task set before the organizers of the Exposition on the banks of the Seine was a stupendous one. During the half century that has elapsed since the inauguration of international exhibitions, the craze for them has waxed and waned, and has at last shown signs of approaching decrepitude, so that it is no exaggeration to say that during the last five or six years the most supreme efforts have been put forth by all of the most eminent men in France to make the Exhibition of 1900 the most memorable in the history of mankind. The task was no easy one. To galvanize into life a moribund institution, to eclipse all that Paris has done in the past, to teach without being tiresome, and to amuse and interest without being vulgar or trivial, such were but a few of the thousand aspects of the problem, and an examination of the Exposition shows that the result will be both successful and brilliant.

The total area of the Exhibition grounds is 270 acres; and the expenditure is estimated at twelve and a half million dollars, but it will doubtless greatly exceed this sum. It has been declared with more or less truth that the successful exhibitions in Paris have been characterized, among other things, with the alternate predominance of the architect and the engineer, and certain it is that the Exhibition of 1889 was a triumph for the latter. The Eiffel Tower dominated the entire scene and diverted attention from almost everything else. This year, however, the engineer will be, comparatively speaking, in the background, and the architect will have his day. The problem put before the architects of every section has been to symbolize in stone, or its imitation, the objects for which each building was destined. First among these comes M. Binet, the designer of the main entrance gateway of the Exposition on the Place de la Concorde. It may be regarded as a most dangerous experiment, and the result is far from satisfactory. The gateway epitomizes the whole Exhibition. It is of grandiose proportions, brilliant coloring, and profuse decoration. It consists of three large bays which support a circular crown on which rests the cupola. On either side of the front bay is a minaret visible from all parts of the city. These minarets are connected with the main structure by friezes, the subjects being shown in our engravings, for which we are indebted to The Buffalo Express. It is impossible to state the style of architecture he has adopted for this entrance. It seems to suggest the Byzantine epoch; it certainly suggests the East. The "Grand Palais," the "Petit Palais," and the "Alexander III." Bridge form the principal elements in the large new avenue opened up by the Champs Elysées, crossing the Seine and terminating with the gilded dome of the Invalides. The Grand Palais is to be a

"THE WORKERS OF THE WORLD BRINGING THE FRUITS OF THEIR LABORS TO THE PARIS EXPOSITION"—FRIEZES AT LEFT OF THE GREAT ARCH AT ENTRANCE TO THE GROUNDS.

CHAMPS ELYSEES SIDE, LEFT ON ENTERING, SECTIONS I AND II.

permanent structure and will be a monumental addition to the public buildings of Paris. It is an ideal building for the exhibition of works of art. After the Exposition it will be used for the same purpose as the Palais of Industry which was destroyed to make way for it, and here will be held the annual salon. The total cost of the building was $4,000,000. The Petit Palais is the work of M. Girault, and is intended for the Retrospective Art Exposition, and will be used as a permanent gallery of modern painting and sculpture. This cost $2,000,000. The bridge which connects two sections of the Exposition was built with special reference to the architectural effect, and the pylons decorated with sculpture will be most beautiful. The entire cost of the bridge was $1,400,000, and a large part of this was devoted to the purely architectural features. All the buildings facing the avenue which leads from

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the bridge are of a temporary character. The numerous buildings on the Esplanade des Invalides and the Champ de Mars seem well adapted for their purpose, but it must be said that some of them are not particularly beautiful and decoration seems to run riot. The native workmen who have constructed many of the buildings devoted to semi-civilized and uncivilized countries and colonies have shown themselves to be wonderful mechanics, and our engraving, for which we are indebted to Für Alle Welt, shows natives carving wood in the Indo-Chinese Pavilion.

Rich gold mines have been found in the Quantung Peninsula of China.

PHOTOGRAPHIC NOTES.

PHOTOGRAPHY AS AN AID TO SPECTRUM ANALYSIS AND THE HIGHER SCIENTIFIC RESEARCH.

A LONG article, contributed by Dr. E. Haschek, to the second January issue of the Photographisches Centralblatt (p. 29), traces up the history of spectrum analysis, and gives an instructive summary of the very great service which photography has done to this important branch of scientific investigation, a mode of investigation which has not only taught us much as to the chemical nature of the fixed stars (among which we may catalogue the sun of our own planetary system), but which has also guided such investigators as Kirchhoff, Bunsen, and Crookes in the quest for previously unknown elements. Dr. Haschek's long and instructive memoir is obviously rather adapted for slow and careful reading by the student than for abstraction in a paragraph; still, in a paragraph one may mention the tribute paid to Prof. Rowland, whose concave gratings, ruled with over fourteen thousand lines to the inch, together with photography as a means of accurate record, have made it possible to recognize wave-lengths to one-thousandth part of the Angström unit; this being a ten-millionth of a millimeter, and commonly indicated in English physical books by the symbol λ. The paramount status of photography as a means of record in spectrum analysis may be gathered from the enormous number of lines which occur in the invisible ultra-violet of the spectrum; for example, the spark spectrum of uranium has no less than 5,270 in the region (invisible ultra-violet) between λ 4,700 and λ 2,000. The close study of the spectral lines (some 100,000 of which have been mapped out or measured) may be looked upon as the most promising of fields for physical research, as relations between these lines and the atomic weights are beginning to be recognized, and patient study in this direction seems not unlikely to lead to greater discoveries than any which have hitherto illumined humanity. The spectroscope, aided by photography, has taught us that which we could have learned by no other means, the drift of the fixed stars in the line of vision. This is shown by a slight shift of the spectral lines, the wave length of the light being virtually shortened when the radiant body is approaching, and lengthened when the radiant body is receding. An apt illustration of the corresponding phenomenon in the case of sound is afforded by the whistle of a locomotive; which in approaching a hearer gives him a higher note than when the locomotive is receding. This is very obvious to passengers in a train which meets another train, of which the whistle is sounding; the change of pitch as the trains pass each other being very considerable, if both trains are at full speed.

DEVELOPMENT OF UNDEREXPOSED PLATES—A STEP-BY-STEP SYSTEM.

In the course of some experiments which are mentioned in the Photographisches Centralblatt (January 2d issue, 1900, p. 35), Herr Josef Schwarz had occasion to develop a plate which had received exposure no less than 2,610 times the normal. His intention was to have used a metol-hydroquinone developer of 2½ times the usual strength, when reversal would have been expected in the ordinary course of things, but to his surprise he obtained an ordinary negative, which was in no way fogged. This matter, however, was explained when he found that he had failed to add the alkali to the developer. In the end he established the general position that if a developer which is altogether without alkali is employed, enormously exposed plates develop normally; but in his experiments he chiefly used paramidophenol and metol-hydroquinone. Extreme over-exposure has very seldom to be dealt with in actual practice, so a more special interest centers on Herr Schwarz's observation that a delicately controlled development for over-exposure may be realized by using a double quantity of the developer in two dishes, one dish containing the alkaline constituents of the developer and the other dish containing the characteristic reducing agent. The plate is first immersed in the reducing agent, and if the image does not appear, or if it fails to gain sufficient intensity, the plate is immersed for a few seconds in the dish containing the alkaline solution, after which it may be once more transferred to the reducing solution, the transfer from dish to dish being repeated according to the behavior of the plate. When the over-exposure is not very considerable, it is sometimes an advantage to immerse the plate in the alkaline solution first. This kind of step-by-step development appears likely to be valuable in many cases when it is desirable to carefully watch and control the results; but Herr Schwarz says his method should not be adopted when under-exposure is suspected.

THE REFRACTIVE INDICES OF THE METALS.

The possibility of attributing a true index of refraction to so opaque a body as a metal has been more or less a problem since the time of Brewster, who gave a table of the refractive indices of metals (Brewster's "Optics," 1851 edition, p. 230). Brewster assumed the angle at which elliptical polarization is produced by one reflection to be the maximum polarizing angle of the metal; and, following the usual rule for polarization by reflection from transparent substances, he took the tangent as the index of refraction. The whole subject is revived in relation to modern research and speculation by an article contributed to the Zeitschrift für Physicalische Chemie, by Herr Aubel; this article being abstracted in The Journal of the Chemical Society for March, 1900 (p. 125 of abstracts relating to general and physical chemistry). From this abstract we take the following: "The indices of refraction of metals, as obtained by calculation from the molecular refraction of salt solutions, were compared with those obtained directly by Drude (Ann. Phys. Chem., 1890 [ii], 37·537). There was fair agreement in some cases, but in other cases a different order of magnitude seemed to obtain; for example, silver, 2·37 and 0·203. Kundt's law (index of refraction ÷ electrical conductivity = constant) did not appear to hold good for either series. We may remark that the question of the refractive index of metals has several crucial bearings on photographic matters; for example, it is difficult to see how the Lippmann process is to be fully explained unless by assuming mercury to have a higher refractive index than the colloid material of the film.

PHOTOGRAPHIC PRINTING ON MARBLE.

A method which can scarcely be regarded as altogether new (as in its main feature it is practically the process of Niepce, which takes us back to about 1820) is given in the February 15 issue of the Bulletin de la Société Française de Photographie (p. 116) as having been published in a recent issue of the organ of the Gironde Photographic Society. A sensitive varnish is made by dissolving 50 grammes of Judea bitumen and 5 grammes of beeswax in a mixture of 500 grammes of benzole and 500 grammes of oil of turpentine. The marble should be carefully smooth-ground and cleaned, but ought not to be polished. After having been coated with the sensitive varnish and dried, the marble is exposed under a negative for about twenty minutes in bright sunshine. Oil of turpentine, poured over the surface again and again, will now dissolve away the unexposed portions of the bitumen, leaving a positive print adhering to the marble. Washing under the tap drives off the film of turpentine from the surface, and after this only drying is necessary. A variation of the process is to use a positive instead of a negative for the original exposure, and after the bitumen is dry the marble is stained by means of an alcoholic solution of a coal tar dye. The bitumen image, which has served as a resist against the dye, is next scrubbed off by means of benzole applied with a stiff brush, leaving a stained-in positive on the marble.

PHOTOGRAPHING SNOW CRYSTALS.

Dr. Neuhauss gives some practical hints in the

Photographische Rundschau (February, 1900, p. 31), and he also emphasizes the interest of this application of photography to meteorological investigation, changes in form and grouping taking place very suddenly during a fall. He says it is useless to attempt this class of work when the temperature is above 5° Centigrade, and he recommends a photomicrographic apparatus of ordinary type, all possible adjustments being made beforehand, and the whole apparatus being set up out of doors. A petroleum lamp was employed as a source of light, his work being done at night; but this had naturally to be inclosed in a glass casing as a protection. To reduce the heat rays coming from the lamp, a cell containing a saturated solution of ferrous sulphate was interposed. As a snowflake, when caught on a glass slide, does not readily fall off, the photomicrographic apparatus may be tilted as convenience dictates. Exposure was about ten seconds, with a projection objective of 30 millimeters focal length.—The Amateur Photographer.

THE NEW ALEXANDER III. BRIDGE AT PARIS.

SCIENTIFIC PROGRESS ABROAD.*

Two recent French discoveries can hardly fail to have an importance influence upon the development of wireless telegraphy. One of them is due to C. Tissot, who found in the course of some signaling work between Brest and Ushant that when the coherer substance was magnetic and the coherer was placed in a magnetic field, not only was the sensitiveness increased, but the durability and regularity of action of the apparatus were very considerably extended. The filings may be of iron, steel, nickel or cobalt. The electrodes may be magnetic or non-magnetic, but the field should be parallel to the axis of the tube and not too strong, as otherwise the decohering process is retarded. The distance between the electrodes may be increased five or even ten times. The sensitiveness is easily regulated by altering the magnetic field—a circumstance of considerable practical utility. If the magnetic field is suppressed while the coherer is still in a state of low resistance, the latter remains in a very unstable condition, which is upset by the least tremor. By controlling the magnet with a relay from the coherer circuit the coherer might be made self-righting. But M. Tissot gives no details of experiments in this direction.

An even more important discovery is that by T. Tommasina. Last year he described a highly sensitive carbon coherer, which could be made to decohere by breaking its circuit. He has since found that a certain kind of carbon powder does not even require this, but decoheres itself automatically. The kind of carbon powder used is that employed in the microphones of the Swiss telephone stations. M. Tommasina introduces it into a telephone receiver. A hole, two millimeters in diameter, is drilled into a plate of ebonite, 2·5 millimeters thick. It is filled with the well-dried carbon powder and closed up with plates of mica. Two German-silver wires are led in from the sides and press against the powder, their ends being about one millimeter apart. The wire of the telephone magnet is cut and the coherer inserted. One dry cell suffices to work the coherer, the impact of each wave being indicated by a very audible click in the telephone. M. Tommasina proposes to insert the coherer in the circuit of a Morse instrument and so solve the problem of the rapid transmission of radiographic signals.

In the domain of Becquerel rays an addition to the number of radio-active substances has been made by A. Debierne. Up to the present we have had radio-activity exhibited by uranium, thorium, radium (resembling barium) and polonium (resembling bismuth). The new substance is called actinium and belongs to the iron group. Its reactions resemble those of titanium and it is obtained from pitch blende, by successive treatment with the reagents used to isolate the iron group, followed by sodium hyposulphite, hydrofluoric acid, and sulphuric acid. Its rays have the same properties as radium rays. M. Debierne supposes that actinium is the active principle of thorium.

Meanwhile our knowledge concerning these and other Becquerel rays is being rapidly extended. H. Becquerel himself has followed up Curie's discovery that radium rays convey a negative electric charge, and has determined the amount of deflection they undergo in an electrostatic field. If they resemble cathode rays in so many respects, he argued, then they probably are composed of particles which are not only deflected by a magnetic, but also by an electric field. After many failures, he succeeded with the aid of an electrostatic field of enormous strength—a billion C. G. S. units—in deflecting a radium beam to the extent of four millimeters. Comparing this with its magnetic deviation, the ratio between the charge of each particle and its mass came out as about 10^7, or of the same order as the ratio for cathode particles.

This result is of fundamental importance. Comparing it with the Zeeman phenomenon, we find that the ions of ultra-violet light would have some such charge-ratio. But, of course, no comparison must be insisted upon, owing to the rough approximation of the figures. It is interesting, however, to note that, according to R. J. Strutt, uranium rays hold an intermediate position between cathode and Röntgen rays as regards magnetic deflection. To produce a curvature of radius of one centimeter would require a magnetic field of 315 units in the case of cathode rays, 5,000 units in the case of uranium rays, and at least 60,000,000 units in the case of Röntgen rays. Whatever may be the surviving view with regard to the wave-nature of Röntgen rays, Becquerel seems strongly inclined to think that the rays named after him consist of projected particles. The rate at which energy is radiated by one square centimeter of a radium preparation is a few ten-millionths of a watt, and as this would only require the expenditure of one milligramme of matter in 1,000 million years, the apparent absence of a decrease in weight is no longer mysterious.

The conveyance of an electric charge by cathode and Becquerel particles lends a new interest to the inquiry as to whether an electric charge is conveyed by the vapor escaping from an electrified liquid, as is done by a fine charged powder blown away from the main mass. The supposition of such a loss was the basis of Exner's theory of atmospheric electricity, and it was apparently confirmed by some results obtained by Pellat. G. Schwalbe has since repeated those and other experiments, and attained a clearly negative result. W. Craig Henderson has also proved that an evaporating metal, like boiling sodium, does not lose any charge by evaporation. It appears, therefore, that a liquid is somehow charged as a whole, while its individual particles are not.

Another interesting controversy is that about the question whether there is such a thing as electric convection of the charged particles in a vacuum tube. J. J. Thomson found evidences of such a convection in a mixture of chlorine and hydrogen by means of the spectroscope. Morris-Airey tried to disprove it by means of double vacuum tube, having two successive sets of electrodes. But it appears that the order in time of the effects observed by Thomson places the reality of the convection of the chlorine toward the cathode beyond all reasonable doubt. At the same time E. Bouty shows that no gas conducts like an electrolyte, since its conductivity is only established by a breakdown of its resistance at a certain limiting electromotive force. Herein it resembles a dielectric like glass or gutta percha.

A hitherto unknown form of spark discharge has been obtained by E. Ruhmer. It is intermediate between the few strong sparks obtained at great distances and the upward curving flame obtained at short distances between a point and a disk, with the aid of a Wehnelt interrupter. The new discharge consists of fine, wavy spark lines, crossing at very short intervals in fairly regular succession. The wavy sparks are really spirals, whose origin is at present doubtful. They do not seem to be due to any kind of magnetic action, and their discoverer vaguely suggests a difference of phase between successive sparks. A peculiar feature of the discharge is that successive wavelets are displaced toward the disk, at the rate of about one meter per second, which is known to be that of the "electric wind" from the point.

W. F. Barrett has discovered a valuable thermo-electric alloy. It consists of 68·8 parts iron, 25 parts nickel, 5 parts manganese and 1·2 of carbon. Twenty-five strips of this alloy, coupled with pure iron, give an electromotive force of 0·1 volt when held over any flame. But there is no increase of electromotive force after a temperature of 250° has been attained.

A mixture of powders for Lichtenberg figures which gives very fine results consists, according to K. Buerker, of five volumes of flower of sulphur, one of powdered carmine and three of lycopodium seed.—Western Electrician.

* References: Tissot, Comptes Rendus, April 2d; Tommasina, do.; Debierne, do.; Becquerel, Comptes Rendus, March 26; Curie, Comptes Rendus, March 5th; Strutt., Proc. Roy. Soc., March 3d; Schwalbe, Ann. der Phys., No. 2; Henderson, Proc. Roy. Soc., April 4th; Morris-Airey, Phil. Mag., March; Thomson, Phil. Mag., April; Bouty, Electrician (London) March 23d; Ruhmer, Elektrotechn. Ztschr., February 22d; Barrett, Phil. Mag., March; Buerker, Ann. der Phys. No. 3, 1900.

NATIVES CARVING WOOD—INDO-CHINESE PAVILION, PARIS EXPOSITION.

STEEL IN NEW ZEALAND.

THE New Zealand government, says London Engineering, has just published correspondence with the Esteve Steel Company, regarding the outcome of experiments made by the company in the utilization of the iron sand of New Zealand. Although the experiments had not been so full or so complete as was desired, the steel company declares the trials to have been successful, as it had succeeded in making high-class tool steel in the crucible direct from New Zealand sand. It finds no difficulty by the process in eliminating the titanic acid and other impurities. Nearly the whole of the metal in the sand is utilized, and the process of conversion occupies about three hours. The company has also succeeded in agglomerating the sand by itself, without adding any foreign matter, the lumps being as hard as stones. The pig iron produced contains only 0·07 silicon, 0·01 sulphur, 0·03 phosphorus, 0·32 manganese, and no titanium. The company has asked

the government to bear the expense of carrying on some practical experiments in the agglomeration of the sand and in making in a Siemens-Martin furnace tool steel and soft steel, both from the sand so agglomerated and from the sand in its natural state.

NEW OBSERVATIONS ON THE CHEMICAL ACTION OF LIGHT COMPARED WITH THAT OF THE ELECTRIC EFFLUVIUM.*

[Paper of M. Berthelot presented to the French Academy of Sciences.]

THE comparison of the action of light with that of the electric effluvium, or silent discharge effected through gaseous dielectrics is interesting. I have touched on this problem several times in the course of my investigations, remarking the general analogies existing between the two orders of phenomena, especially in my study of the oxidations and polymerizations. The subject is too vast and complex to be dismissed summarily, but it may be useful to describe some new experiments which may aid in settling certain points. Such is the object of the present paper.

The experiments related to the action of light on carbon sulphide and on benzine in a pure state, or

In presence of hydrogen,
In presence of mercury,
In presence of argon.

Benzine.—The pure benzine was placed in sealed glass tubes and exposed to light both diffused and intensely solar for three months, at the ordinary temperature in our climate. It did not appear to me to experience any change.

The same experiment, repeated in sealed tubes, containing pure and dry hydrogen, resulted in no combination of hydrogen.

Nor does the benzine combine with a trace of argon under the same conditions. The experiment was made with benzine saturated cold with argon in such conditions that a slight elevation of temperature disengaged 2 c. c. or 3 c. c., which rendered the experiment conclusive.

These experiments were repeated in presence of mercury in the eprouvettes, also for a period of three months. Under these conditions the crystallizable benzine which I had in hand scarcely attacked the mercury in diffuse light. But under the direct rays of the sun a brown precipitate was formed, determined by the presence of traces of sulphur, proceeding without doubt from traces of thiophene which the benzine still retained.

Neither hydrogen nor argon was absorbed by the benzine in such conditions.

These results contrast with the experiments made with the concurrence of the effluvium; hydrogen, nitrogen, argon, being absorbed under the latter influence.

I recall the fact that benzine absorbs oxygen slowly under the influence of light, forming polymerized resinous matter.

Carbon Sulphide.—The carbon sulphide was put in action in two forms, liquid and gaseous (with traces of liquid in excess), still in tubes sealed with the lamp. Neither hydrogen nor argon was absorbed under these circumstances by the action of the solar light, direct or diffused, in three months.

It is known that carbon sulphide is changed rapidly and immediately, under the influence of direct solar light. But, as I have noticed, the insoluble coating deposited on the surface of the glass soon ceases and almost entirely stops the reaction.

With the diffuse light of the laboratory, according to my former experiments, there is no action, even in the course of several months.

The contrast between the two degrees of luminous action may be verified in the following way:

The sealed tube containing the vapor of carbon sulphide is surrounded in the middle with brown paper, the two extremities remaining free and alone exposed to the solar light. After some days, or better after some weeks or some months, the tube is uncovered, and it is found that the parts exposed to the sun are overspread with a brown coating, while the part protected by the paper remains transparent, although the diffuse light is able to penetrate obliquely.

The result is the same with a sealed tube filled with liquid carbon sulphide.

In presence of mercury, carbon sulphide furnishes a black deposit, either in diffuse light or in the direct solar light. But, in these conditions, it is not combined either with hydrogen or with argon, still affording a contrast between the reactions of the light and those of the effluvium.

I will now give the detail of a trial of effluvium, made with carbon sulphide and argon in diffuse light, an experiment which exhibits a contrary reaction of the effluvium.

I operated on the following gaseous mixture, prepared at 28° C. under a pressure of 0·749 m.:

Argon	100 by volume.
Gaseous CS^2	80 " "

This mixture was introduced into an effluvium tube on July 22, 1899. But instead of operating with strong intermittent tensions of an induction coil, I put in action a Leclanché battery, of which the continuous tension was equal to 200 volts.

One of the poles communicated with the exterior metallic spiral of the effluvium tube, the other pole with the dilute sulphuric acid of the interior siphon. In these conditions the operation is without alternative discharges on account of the constant tension resulting from the difference of potential between the two poles. The electricity is transmitted slowly by means of the dielectrics, glass and gas, and its chemical action is decided.

The experiment lasted for three months until October 26. The difference of potential (200 volts) continued to the end, as verified by the measures taken from time to time. At the close the temperature was 12·4°; the pressure 0·750 m.

The gaseous mixture, brought back to the initial temperature and pressure, contained:

Argon	100
Gaseous CS^2	36

The argon, therefore, was altogether unchanged, while sixty one-hundredths of the gaseous carbon sulphide had disappeared, being changed into yellow products condensed on the walls. This change appeared due to the action of the effluvium, for the tube underwent no direct action of the solar light; that is, it was kept in a condition where the carbon sulphide was not changed, even at the end of several months.

It would be quite interesting to pursue methodical researches similar to the preceding for comparison between the influences that heat, light, the different kinds of luminous radiations (other than those of heat), and electricity under the different forms, slow or rapid, of its discharges, exercise on chemical phenomena.—Translated from the French Annales de Chimie et de Physique.

* The word effluve (effluvium) has by extension come into use to denote the silent or convective discharge occurring through the repulsion of air or gas particles that carry off minute charges. Various apparatus has been employed by M. Berthelot in his laboratory for utilizing this action effectively. More ozone is thus produced than by the sparking discharge. Note by translator.

X-RAY BULBS WITH COOLED ANTICATHODES.

AN article that appeared in this journal not long ago gave a description of MM. Buguet and Chabaud's bulb with cold anticathodes. In this article the author pointed out the serious inconvenience due to the rapid heating of the anticathode of ordinary bulbs, and stated that several researches had already been made with a view to cooling the anticathode by a circulation of cold water, but that they had given no practical results. It is this last point that I am desirous of rectifying. In fact, I was the first, as long ago as the end of the year 1896, to make known such process of cooling the anticathode, and had several types of bulbs of this kind constructed by M. Seguy.

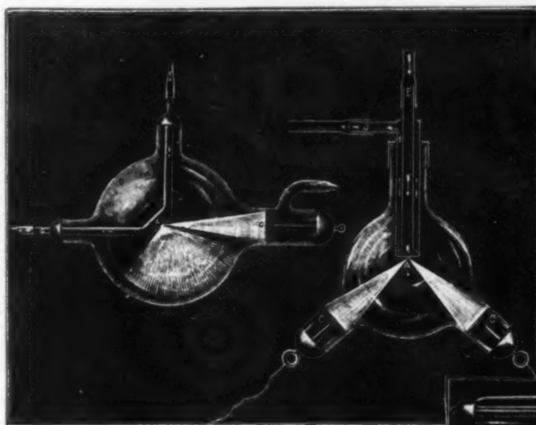


FIG. 1.—BRETON BULBS WITH COOLED ANTICATHODE.

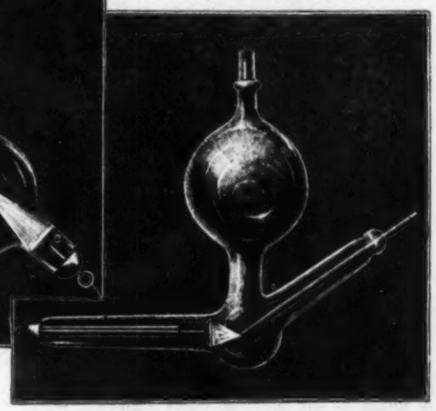


FIG. 2.—ANOTHER TYPE OF BULB WITH COOLED ANTICATHODE.

I described two of these bulbs in a note deposited under cover at the Academy, and again in my work entitled "Cathodic Rays and X-Rays," which appeared at the beginning of the year 1897. Fig. 1 represents these two bulbs and shows their method of operation so clearly that it is unnecessary to dwell upon the subject.

At this epoch, such apparatus possessed but a relative importance, because of the feeble power of the generators and transformers of electricity utilized for the production of X-rays.

It was only in a few types of bulbs with a small anticathode that cooling by a current of water offered any real advantage. But the currents utilized in radiography continued to increase in power, and I was, consequently, led toward the end of the year 1898 to study new types of bulbs with cooling arrangements. At this time I saw M. Chabaud about the construction of one of these bulbs, but finally had it manufactured by M. Grisel, an expert glassblower. This bulb, which was constructed more than a year ago, is represented in Fig. 2, while Fig. 3 shows the manner in which it is used for the radiography of a case of sheaths placed upon the frame that contains the sensitized plate.

As may be seen from these figures, this apparatus differs very slightly from the Buguet and Chabaud bulb recently described.

The cathode consists of a spherical cap, and presents no peculiarity. The anode, which serves at the same time as an anticathode, is, on the contrary, formed of a platinum tube that traverses the right hand branch of the bulb and is soldered in its end. The inner end of this platinum tube is closed by a plane surface forming an anticathode.

A small copper tube inside the platinum one (see Fig. 3), and connected by a rubber tube with a reservoir above, leads a current of cold water against the anticathodic end. This water escapes through a second rubber tube fitted to the platinum one. The tube through which the water enters traverses the wall of the tube through which the liquid makes its exit, and extends to the bottom of the platinum tube.

Upon properly regulating the current of water it is thus possible to keep the anticathode at the temperature desired, and absolutely to prevent its heating.

This kind of a cooled bulb, for which I think I can claim priority, therefore prevents genuine advantages, which will gradually become greater in measure as an endeavor is made to increase the power of X-ray generators.—J. L. Breton, in La Nature.

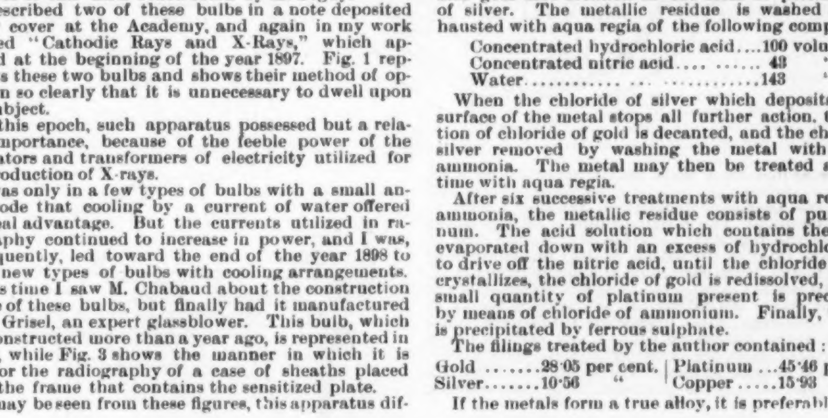


FIG. 3.—APPARATUS FOR RADIOGRAPHING WITH COOLED ANTICATHODE.

THE COMMERCIAL SEPARATION OF PLATINUM FROM GOLD.

By E. PRIWOZNIK.

SCRAPS, filings, etc., of gold containing platinum are put on one side in minting operations, as the ordinary methods of gold refining cannot be applied to them with success. The following method has been successfully used by the author when dealing with large quantities of such scrap.

The sifted filings are digested with nitric acid of 1·199 density, until no more silver is dissolved. During this operation a small quantity of platinum also goes into solution in the form of platino-nitrite of silver. The metallic residue is washed and exhausted with aqua regia of the following composition:

Concentrated hydrochloric acid	100 volumes.
Concentrated nitric acid	43 "
Water	143 "

When the chloride of silver which deposits on the surface of the metal stops all further action, the solution of chloride of gold is decanted, and the chloride of silver removed by washing the metal with a little ammonia. The metal may then be treated a second time with aqua regia.

After six successive treatments with aqua regia and ammonia, the metallic residue consists of pure platinum. The acid solution which contains the gold is evaporated down with an excess of hydrochloric acid to drive off the nitric acid, until the chloride of gold crystallizes, the chloride of gold is redissolved, and the small quantity of platinum present is precipitated by means of chloride of ammonium. Finally, the gold is precipitated by ferrous sulphate.

The filings treated by the author contained:

Gold	28·05 per cent.	Platinum	45·46 per cent.
Silver	10·56 "	Copper	15·93 "

If the metals form a true alloy, it is preferable to pre-

viously melt this alloy with 3 parts of lead, or what is even better, 3 parts of zinc. The metal is then granulated and treated with sulphuric acid, which dissolves the zinc, and the spongy residue is treated in the manner above described.—Oesterr. Zeits. f. Berg. u. Hüttenwesen, 1899, p. 356.

RUSSIAN SAVINGS BANKS.

STATISTICS regarding the working of the savings banks of Russia in 1899 have been published lately, and it is interesting to find that savings bank deposits go on increasing every year. On January 1, 1899, the aggregate deposits in connection with 2,792,000 accounts amounted to 593,300,000 rubles, of which sum 537,300,000 rubles were paid in in cash and 56,000,000 rubles in stocks and shares. During 1899, 386,200,000 rubles were deposited, while 300,700,000 rubles were repaid, thus showing an increase of 85,500,000 rubles and raising the aggregate deposits on January 1, 1900, to 678,800,000 rubles. The various groups of savings banks represent the following amounts, all forming part of the above total of 678,800,000 rubles: St. Petersburg savings banks, 44,100,000 rubles; Moscow savings banks, 41,100,000 rubles; savings banks at the branches of the Imperial Bank, 209,800,000 rubles; savings banks at the tax collecting offices, 279,000,000 rubles; post office savings banks, 100,600,000 rubles; and savings banks of a private character, 4,200,000 rubles. The above-mentioned increase in deposits of 85,500,000 rubles is a record one, as may be gathered from the following table:

YEARLY INCREASE (IN MILLIONS OF RUBLES).

Year.	Deposits in cash.	Deposits in stocks and shares.	Totals.
1895	37·6	5·9	43·5
1896	41·5	10·4	51·9
1897	56·2	11·7	68·0
1898	71·6	11·1	82·7
1899	70·1	15·4	85·5

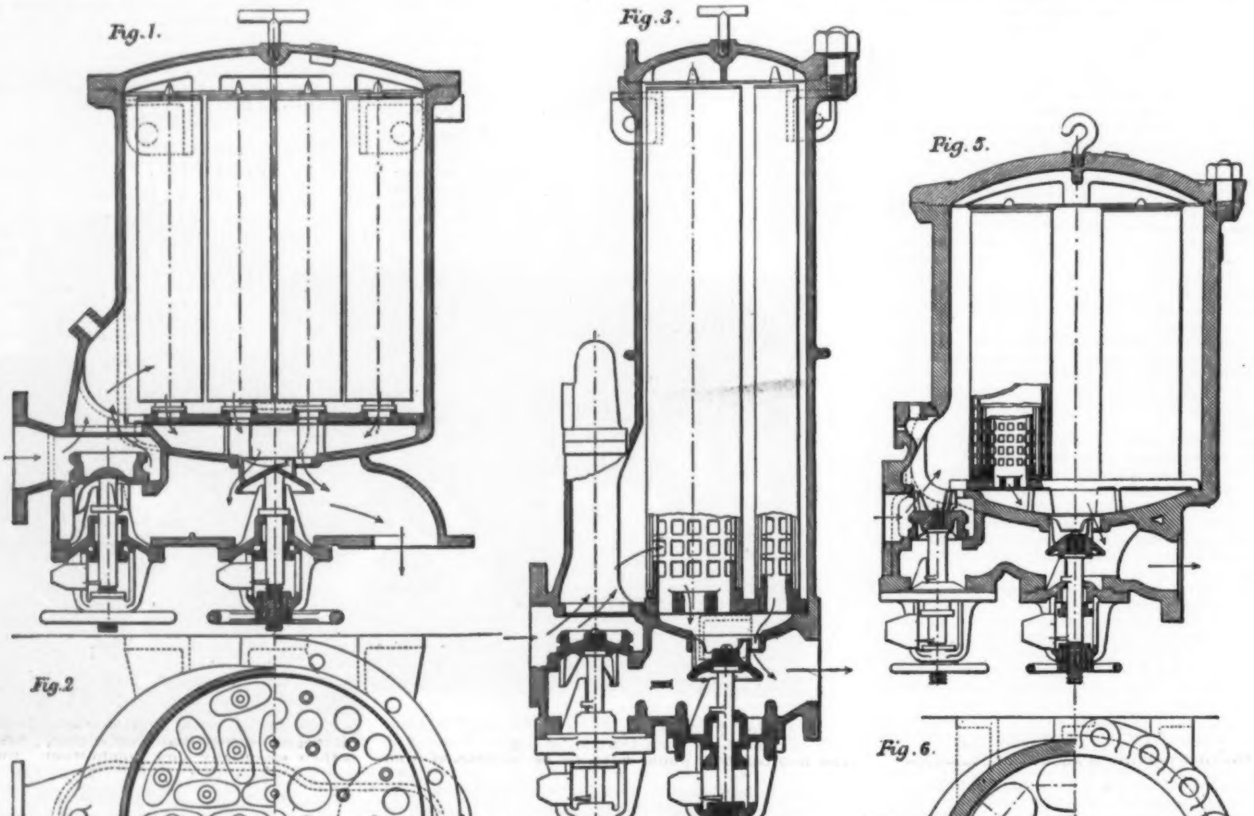
This substantial increase in deposits is chiefly attributable to the large increase in the number of savings banks offices throughout the country; thus, in 1899, 194 new savings banks offices were opened, bringing up the aggregate number to 4,770. In order to accustom the people more and more to the savings banks, it has been suggested that certain simplifications should be carried out in the formalities connected with deposit and withdrawal of money. Moreover, it is proposed to open savings banks offices in connection with all the governmental spirit shops. The latter suggestion, however, seems to savor somewhat of irony.—Bradstreets.

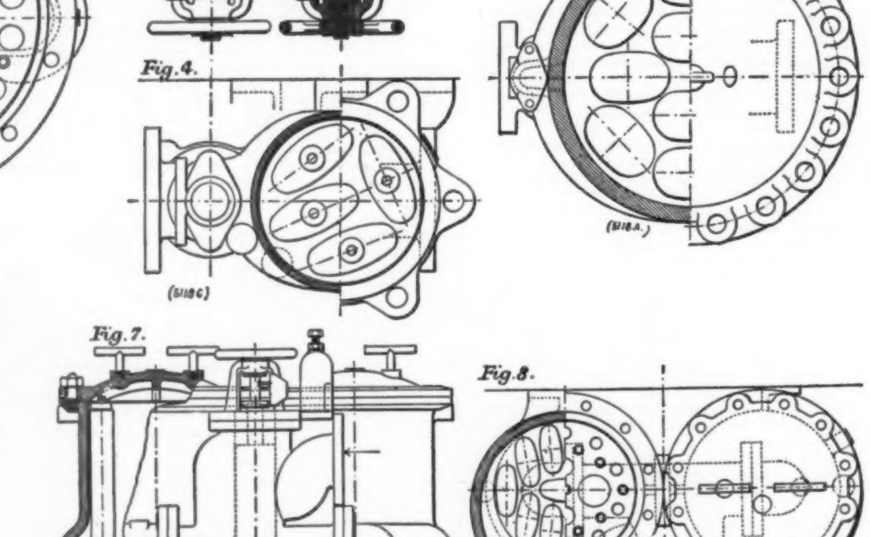
GRAHAMITE.

GRAHAMITE is not produced in the United States at present, says Mines and Mining, and it is uncertain where that particular mineral is produced in any other country, for there are many varieties of asphaltum and one might be called grahamite. In former years it was produced under the name of Ritchie mineral in Ritchie County, West Virginia, but none has been mined there, so far as is known, for the last fifteen or twenty years. Gilsonite, another form of pure asphaltum, is mined in Colorado and Utah by the Gilsonite Asphaltum Company, of St. Louis, and the Colorado Gilsonite Company, of the same city. Also by the Assyrian Asphalt Company, of Chicago, Ill. A similar and yet dissimilar asphaltum is mined in Uvalde County, Tex.

WATSON'S FEED-WATER FILTERS.

IN these days of high pressures, and especially since the introduction of water-tube boilers, the importance of pure feed water is being more and more realized. Boilers must be kept free from grease and oil, and if filters are not fitted, this condition of things can only be attained by using no lubricants in the cylinders or ing harm being caused to the boilers. Feed-water filters are now largely adopted for trapping oils and other impurities held in suspension in feed-water. The special aim is to get large effective filtering area, with compactness and accessibility, for the speed of the fluid through the filtering medium is directly proportional to the superficial cloth area presented, and the larger the area the slower the speed for a given quantity of water to pass, and the easier and more effectively the medium retains the impurities contained in the feed-water. A large filtering area also enables the filter to be in use for a longer period without cleaning or changing of the medium. The drawings of Watson's patent feed-water filters, reproduced below, clearly showing their general arrangement, will explain how far the designs attain the desiderata of an effective and efficient filter, as indicated.





WATSON'S FEED-WATER FILTERS.

valves of the main or auxiliary engines. Some engineers dispense with the greater number of lubricators on the cylinders and casings, trusting to the moisture of the steam to lubricate the working faces, but wet steam is an expensive lubricant. Besides, the cylinder walls and valve faces in such cases cannot be kept in order if the engine should stand for any time. Again, a certain amount of oil must enter the main cylinders through the swabbing of piston-rods and valve spindles and also through the high-speed auxiliary machinery, so that a considerable amount of oil finds its way into the condenser. Oil and grease, therefore, is found in a greater or less degree in the condensed steam returned to the boilers as feed, and it becomes a question as to what is the cheapest and simplest method of prevent-

In order to obtain extra large filtering area in the smallest possible space, the Watson filter is fitted with specially shaped frames, as shown on the plans, in which the ratio between the external or circumferential surface which constitutes the filtering area and the sectional area or space occupied by the frame is much larger than where circular-shaped frames are used. Therefore, in a given space a larger filtering area by 30 to 50 per cent. can be introduced. A number of frames are always to be preferred to one large frame, as small parts of the total filtering medium can be renewed more quickly and cheaply. Again, when a number of separate frames are used, these should be so situated that any one can be removed, examined, and replaced without disturbing any other.

In our illustrations Figs. 1 and 2 show a low-pressure suction filter for war vessels; Figs. 3 and 4 a high-pressure single-feed filter for torpedo boat destroyer; Figs. 5 and 6 a high-pressure triple cartridge filter for battleships fitted with Belleville boilers; and Figs. 7 and 8 a high-pressure double-feed filter, as made by Messrs. Henry Watson & Son for electric light stations. For the discharge side of the feed pumps Messrs. Watson's filters have been made for feed pressures up to 600 pounds per square inch, while for use on the suction side they are of the low-pressure gravitation type. They are made for single, double, or treble filtration, and are often arranged on the duplex system with change valves for use in electric light stations. Some of these filters have been made containing 20,000 square inches of effective filtering area within a total weight of 750 pounds, and occupying less than 16 cubic feet space; this result has been attained without use of aluminium. Where reduction of weight is of great importance, high-pressure filters for over 6,000 indicated horse power have been made weighing undeg 350 pounds complete.

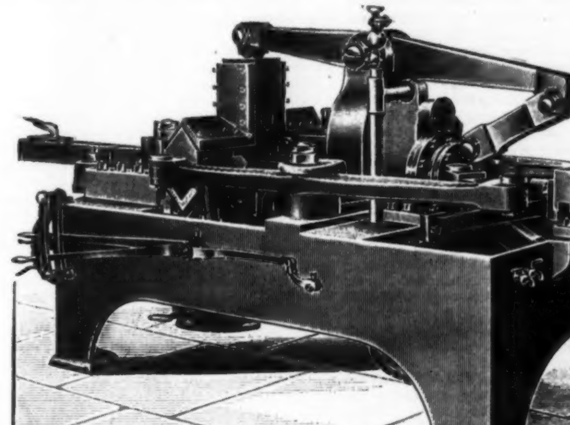
Messrs. Watson's special oil extractors are also in some cases fitted in the auxiliary exhaust-pipe ranges, and are in addition to the usual filtering medium provided with a series of specially shaped deflectors which arrest or separate a portion of the oil-covered water globules carried along with the exhaust steam. The remaining finely divided grease is dealt with by different media, through which the exhaust steam passes on its way to the condenser. Messrs. Watson, it may be added, have at present feed-water filters in course of construction for 250,000 indicated horse power.

We are indebted to London Engineering for the engraving and description.

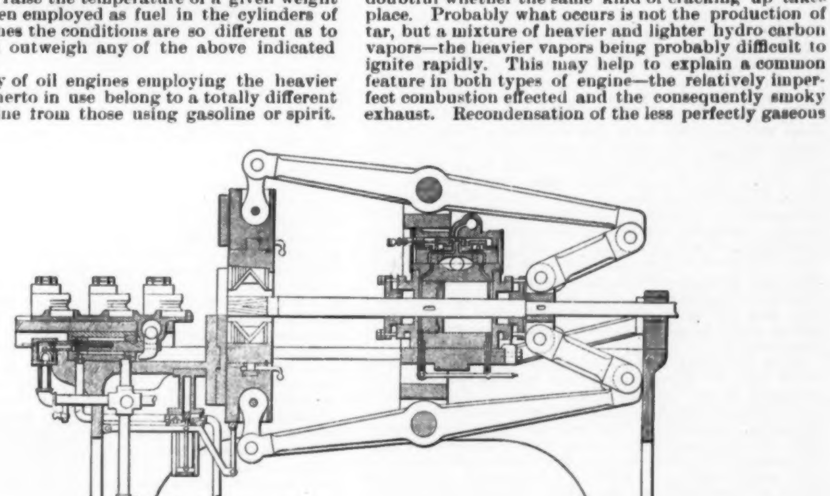
STAR DRILL FORGING MACHINE.

THE process of forging by hand and sharpening or repairing star rock drills form a very important item in the cost of working mines where hard rocks have to be attacked. It is with the object of decreasing this heavy expenditure by the use of mechanical means that the forging machine illustrated by a wood cut and a sectional drawing on this page has been designed. A very few words of explanation will make its action clear. It consists essentially of a steam or air cylinder in which works a piston. Near the front end of this cylinder are four radial guides, in which hammers or blocks of cast steel carrying the fluting tools slide. An inspection of the drawing will show at once the manner in which these four blocks are driven together simultaneously by a system of levers when the piston moves. The bar to be worked on is held by an adjustable vise in the right position, and fed forward by a ratchet mechanism, and the action of the dies forms its end into the + section. The V-shaped cutting edge or bevel is given by a tool or "dolly" attached to the end of the piston-rod. It has two V grooves crossing each other in its face, which is caused to impinge upon the end of the star, thus producing the desired conformation. The fluting tool and the dolly act, it will be observed, alternately. The drills are made at one heat, and the time per drill is about three minutes.

This machine, says London Engineer, is the invention of Mr. Palmer, and is made by Harvey & Williams, Limited, Huntingdon.



PALMER'S DRILL FORGING MACHINE.



SECTION OF FORGING MACHINE.

OILS AS A SOURCE OF ENERGY IN EXPLOSION ENGINES.

THE great merit of the oil engine as a source of power is its economy of fuel. It is this feature which renders the future prospects of the oil car in competition with its formidable rivals—steam and electricity—so satisfactory, and the equanimity of its supporters, despite the difficulties with which they have to contend, so hard to disturb. Whatever the steam car and the electric car may be, the oil car will probably always hold its own, especially when we consider the strides that have been and are being made to eliminate its most objectionable features—the noise and smell of the exhaust and the vibration—which have largely characterized it in the past. At the same time, the introduction of variable speed oil engines is tending very largely to increase the flexibility of oil as a motive power. Certain aspects of oil fuel as applied to oil engines, therefore, possess an interest for those engaged in the development of the industry and for the general public as well.

The chief sources of the oils employed as the motive power of oil engines are the oil wells of Pennsylvania and those of Baku and its neighborhood on the shores of the Caspian. The crude oil which rises to the surface of its own accord, owing to the pressure it is under in the oil-bearing stratum into which the bore hole or oil well is driven, is a thick oil, usually about the color of treacle. This crude product is first of all dealt with in large boilers, in which it is subjected to fractional distillation. The temperature is gradually raised to about 150 degrees and maintained at that point for some time. During this part of the process the light oils—the gasolines, benzolines, and "motor car spirit"—distill off and are collected by ordinary condensation. Their specific gravity is generally from about 0·60 to 0·70. The temperature is then considerably raised and the distillation of the heavier lamp oils of a gravity of about 0·75 to 0·85 effected. These are subsequently decolorized by a sulphuric acid and washing treatment. The light oils, generally known as benzoline, gasoline, or "motor car spirit," obtained as above described, are, it must be remembered, never benzine (more correctly benzol), but the more volatile members of other hydrocarbon series. The American oils, whether light or heavy, are members of the paraffin series, the lamp oils varying in composition from about C_8H_{18} to $C_{16}H_{34}$. The oils of Baku, according to the Russian chemist Markonikow, who has devoted much study to the subject, are not paraffins, but olefins, belonging to the series C_nH_{2n}, the lamp oils from this source varying from about C_8H_{16} to $C_{16}H_{32}$. A very important fact which cannot be left out of sight when considering the future of the oil motor is that the output of every natural source of petroleum is about at least eight times as much heavy or lamp oil as light oil of the "motor car spirit" type. It would seem to follow, therefore, that the price of the latter must always be considerably higher than that of the former.

The relative merits of different oils as heating agents, and notably of the heavy oils as opposed to the light oils, appears to be shrouded in considerable obscurity. Hydrogen is a very much better fuel than carbon, and it has been customary to assume that, with a hydrocarbon, the heating capacity is proportional to the amount of hydrogen it contains; thus marsh gas is a better fuel than ethylene, and Mr. Boverton Redwood has found that the heating value of the heavier Russian oils is almost exactly in proportion to their content of hydrogen. This is not, however, the case with all hydrocarbons; there are certain anomalies. Thus, acetylene contains only half the hydrogen of olefin. It is, however, a slightly better heating agent, and a heavy American oil of gravity 0·841 has been found to have calorific value of 18,401 units, as against 11,000 units given by a gasoline of the same type, with a gravity of about 0·69. Generally the American gasolines appear inferior as fuels to the American heavy oils, while with the Russian oils the reverse is the case. The anomaly may be due to the manner in which the carbon is combined with the hydrogen. In certain cases there is probably an absorption of heat due to the decomposition of the hydrocarbon. In other cases this does not appear to occur. Where such an absorption of heat takes place, the heat going to decompose the hydrocarbon would have to be subtracted from that produced by its combustion. This is the general rule with chemical compounds. The heat generated by their combustion has to be supplied to effect their decomposition, and the anomaly with the hydrocarbons is that some of them appear to give the full heating value of their elements without any such loss.

These estimates of the calorific value of the hydrocarbon are all made out on the basis of their steam-raising capabilities, or, in other words, their power when burnt to raise the temperature of a given weight of water. When employed as fuel in the cylinders of explosion engines the conditions are so different as to far more than outweigh any of the above indicated anomalies.

The majority of oil engines employing the heavier oils as fuel hitherto in use belong to a totally different type of machine from those using gasoline or spirit. The output of the former, for size and weight of engine, is less, and their consumption of oil per horse-power hour produced is considerably higher than with the latter types of motor. Let us consider how far this comparative inefficiency is inherent in the oil. The great majority of heavy oil motors subject the oil to preliminary treatment in a vaporizer, which is first of all heated up by external means, and subsequently, though not always, kept hot by some of the waste heat of the engine. These motors may be again subdivided into two classes: (1) Those in which the vaporizer is kept hot enough to fire the explosive mixture automatically at the end of the compression stroke; and (2) those in which it is hot enough to vaporize the oil only, additional means having to be supplied, such as an electric spark, to effect the ignition of the charge at the right moment.

In the first of these classes there is practically no question that the vaporizer acts as a gas producer, and that the engine is really running like an inefficient gas engine. The oil squirted into the red-hot vaporizer is "cracked," exactly as in the manufacture of oil gas, into permanent hydrocarbon gases and tar, which ultimately decomposes into carbon and then burns off. Mr. Worby Beaumont, taking into consideration the fact that such an engine when running properly does not become choked with tar or carbon, has advanced the theory that when petroleum oil is brought into contact with a red-hot surface when air is present, it is not cracked up in the same way as when air is absent, as in a retort. The formation of tar, however, in the manufacture of oil gas cannot be prevented by admitting air into the retort. It seems more probable that tar and carbon are formed, though they may burn off partially all the time the engine is running and the vaporizer is hot enough. When once the growth begins its increase is rapid. This is one very important cause of inefficiency in this type of engine. The oil admitted to the vaporizer is split up into two products, one alone of which—the permanent gas—gives energy to the cycle by exploding at the right moment. The other product—the tar and carbon—fails to contribute any material amount of energy to the piston. This is one reason why these engines obtain from the heavy oil fuel less energy than they should. Another reason is their essentially slow combustion. But slow combustion means low horse-power per unit of fuel, because it means less of the energy of each explosion going to propel the piston, and more of it going to heat the cylinder wall, exhaust passages and the water jacket.

The other types of engine in which the vaporizer is not kept at such a high temperature or utilized for firing the charge automatically on compression, but which rely on other means to effect the ignition, differ a good deal in some features from the foregoing. It is doubtful whether the same kind of cracking up takes place. Probably what occurs is not the production of tar, but a mixture of heavier and lighter hydro carbon vapors—the heavier vapors being probably difficult to ignite rapidly. This may help to explain a common feature in both types of engine—the relatively imperfect combustion effected and the consequently smoky exhaust. Recondensation of the less perfectly gaseous elements of the mixture during the intake stroke of the engine tends to increase this effect—the explosion finally vaporizing them too late for use.

The principal feature, however, possessed in common by both these types of motor is that the oil vapor or gas is introduced into the cylinder in a heated state. The result of this is that it is very difficult to get the mixture sufficiently dense to obtain explosions of maximum efficiency, and this is perhaps the most fertile cause of all in lowering their fuel efficiency, and is a defect from which the gasoline engines are relatively free.

Broadly speaking, the gasoline engines may be divided into two classes: (1) Those which employ a carbureter; and (2) those which spray the oil in a mixing chamber more or less immediately communicating with the inlet valve.

The carbureter is an appliance by which air is brought into close contact with the gasoline over an

extended surface, and is in every way comparable to the ether saturaters employed in the production of limelight. The result is to produce a highly carburized inflammable air, and engines working on this principle are to all intents and purposes gas engines.

In the other type a mixture of vaporized and finely sprayed gasoline finds its way into the cylinder, and, becoming fully vaporized on compression, produces a denser and consequently more economical explosive mixture. It is no matter for surprise, therefore, that this type of gasoline or light oil motor develops from 15 per cent. to 20 per cent. more power from the same oil than the former type. Both classes of gasoline motor also work with a very readily fired and rapidly burning fuel. They can therefore run at very high speeds. Here, therefore, we have the solution of their greater economic efficiency; they are able to run at higher speeds, utilizing more of the energy of their explosions in propelling the piston and less in heating the cylinder walls, and they introduce their vapor or mixture of spray and vapor cool into the cylinder and consequently produce more powerful and more economic explosions. That a given weight of gasoline or spirit has been found capable of producing more power than heavy oil is due, therefore, not to its superiority as fuel, but to the characteristics of the motors in which the light and the heavy oils have hitherto respectively been used.

The problem is apparently altogether different when we employ the light and heavy oils under similar conditions. With an engine in which the oil is sprayed directly into the cylinder we have reason to believe that the consumption of oil of comparatively high gravity is less per horse power hour developed than when using lighter oil, provided that complete combustion is obtained. Mr. Dugald Clerk, who, as is well known, has made careful experiments on the subject, states that light oil vapors will stand a higher degree of compression than the vapors of heavy oils without undergoing spontaneous ignition. If this is so it would seem to lead to the conclusion that the dissociation temperature of the lighter oil is greater than that of the heavier oil—i. e., that the amount of heat lost in decomposing it is greater than in the case of heavier oil, and that it is therefore not so good a fuel as its chemical composition would lead us to expect. This quite agrees with the data furnished by its direct employment in the cylinder under analogous circumstances.

The fact, then, that under similar conditions heavy oil is not inferior as a source of power to light oil, but, on the contrary, rather superior, is encouraging for those who, in spite of the many difficulties with which the problem bristles, are working for the development and improvement of the high speed heavy oil motor. Two other facts may serve to encourage them. One is the essentially greater cheapness of the heavier oil, due to its being produced by all oil springs in much greater quantity than the light oil, as pointed out above. The other is the considerably greater amount of trouble, expense and precaution involved in the transport and storage of the lighter oils. These are essential to their nature and composition, and will always tend to restrict their cheapness and the opportunities of readily procuring them.—The Automotor Journal.

RELIC OF DR. LIVINGSTONE.

WHEN Dr. Livingstone died in Central Africa, his faithful followers embalmed the body, carried it to the coast, and it now lies in Westminster Abbey. The heart of the great missionary explorer was, however, buried under a tree beneath whose branches he had breathed his last. One of his servants, Jacob Wainwright by name, carved an inscription on the tree. The part of the tree trunk bearing this inscription, or what is left of it, has just reached London and has been added to the interesting relics of the great explorer in the collection of the Royal Geographical Society, says The New York Sun.

The tree was not seen by any white man for more than twenty years after the explorer's death, though meanwhile a bronze plate or tablet had been sent out by Dr. Livingstone's daughter to mark the place where he died. Valuable presents, also, were sent by the Royal Geographical Society to the chief of the district to induce him to protect the tree and the plate. After many vicissitudes the bronze plate was handed over to Chitambo, son of the chief of the same name, who ruled the district when Livingstone died there. Capt. Bia, the Belgian officer and explorer, delivered the plate to the chief, but Bia was not able to visit the tree, and the tablet was stolen soon after it had been put in place, by an Arab slave trader who was raiding the country.

After Mr. Poulett-Weatherley visited the tree three years ago, he wrote home that although it was still standing, it was in an advanced state of decay and must soon perish, involving the destruction of the inscription, unless some steps were taken for its preservation. The Royal Geographical Society decided to have the section that contains the inscription cut out of the tree and taken to London, to be placed with other relics of Livingstone. Mr. Alfred Sharpe, the British Commissioner in the British Central Africa Protectorate, undertook to carry out the wishes of the society when an opportunity occurred. Finding last year that Mr. R. Codrington was about to visit the region of Lake Bangweolo, he requested him to undertake the work. Mr. Codrington consented to do so, and a little later, under the guidance of Chief Chitambo, he found the tree still standing, but in a very bad condition. When the tree was felled, it was found to be completely hollow. The inscription had been partly effaced by wood borers. So far as it was legible, it was as follows:

DR. LIVINGSTONE,

MAY 4, 1873.

... .zA Mniasere

uchopere.

The section was very heavy and had to be somewhat reduced in size in order to transport it to the sea. When it was unpacked in London, it was found to have stood the journey extremely well, and steps were at once taken for its permanent preservation.

A. MILNE EDWARDS.

THE Museum of Natural History, of Paris, as well as the world of science, has recently met with a severe loss in the death of M. Alphonse Milne Edwards, which occurred during the night between the 20th and 21st of April, in the house in the Jardin des Plantes in which his father expired. It was some months ago that he felt the first attack of the disease that was to prove fatal; but so great was his devotion to the Museum, and so powerful his activity, that, despite the entreaties of his family, he insisted upon pursuing his scientific work and performing the manifold duties that fell upon him as professor and director of a great establishment.

During the winter, he gave the major part of his lessons at the Ecole Supérieure de Pharmacie, and, in the month of March, even began his annual course of lectures at the Museum, and did not seek a substitute until his disease triumphed over his remarkable courage. While suffering severe pain, he presided over the reunion of the Société des Naturalistes that he founded, and a few hours before his end he was still giving instructions relative to the participation of the Museum in the Exposition of 1900.

He preserved, up to his last moments, all the lucidity of his mind, the clearness and brightness of which were the wonder of all who approached him. It is therefore possible to say that M. Edwards died in the harness; and it was his indomitable energy that caused his family and friends to have the most sanguine hopes of his recovery. Everyone thought that he would finally triumph over his disease, and be able, for a long time to come, to pursue a career that had been extremely brilliant.

Born at Paris in 1835, M. Edwards was made doctor of medicine in 1860, and doctor of sciences in 1861. The following year, he entered the Museum as an assistant,

A. MILNE EDWARDS.

was appointed fellow professor in 1864, and soon afterward titulary professor at the Ecole Supérieure de Pharmacie, where he lectured uninterruptedly for thirty-five years. The Ecole des Hautes-Etudes having been founded, he assumed, after being an assistant to his father, the direction of the laboratory, with which he never for a single instant ceased to occupy himself; aiding the students with his valuable advice and putting at their disposal the wealth of his magnificent library. In 1876, he succeeded his father, Henri Milne Edwards, to the chair of Zoology (mammals and birds) of the Museum d'Histoire Naturelle, and for fifteen consecutive years, during the summer semester, gave series of lessons to numerous pupils, who fully appreciated both his vast erudition and the perspicuity of his method of teaching. In 1879, M. Edwards was elected member of the Institute, and in 1885 member of the Académie de Médecine. Finally, in 1892, he was placed at the head of the Museum in which his entire youth had been passed and in the prosperity of which he took so great an interest. In spite of the small allowance made to this establishment, he succeeded in maintaining it in a prosperous condition, and upon a level at least with that occupied by similar institutions in foreign lands. He improved the interior arrangement of the menagerie, presided over the installation of the new galleries of Zoology, and exerted himself to the utmost to bring the services into a more intimate relation by instituting monthly reunions at which the naturalists, physicists and the chemists of the Museum should talk to the assemblage about their work, and at which travelers should relate the circumstances under which they obtained their collections. Besides, in order that an evidence of such seances should remain, he established, along with the Nouvelles Archives, the Bulletin du Museum, designed to make quickly known in France and foreign lands the results obtained in every branch of science. So, in 1899, at the banquet offered by the professors of the Museum to M. Edwards, who had just been promoted to the grade of Commander of the Legion of Honor, M. Albert Gaudry was universally applauded when he thanked the director for the proofs that he was daily giving of his indefatigable devotion, and declared, in using an expression of Flourens, that "the old Museum was at this moment enjoying a second childhood."

From 1880 to 1883, M. Edwards, in conjunction with MM. Perrier, Vaillant, Filhol, Fischer, de Folin and other scientists, on several occasions directed submarine explorations, first in the Gulf of Gascony, and then in the Mediterranean and Atlantic Ocean, the results of which are embodied in a large work, in course of publication, entitled "Expéditions Scientifiques du 'Travailleur' et du 'Talisman.'"

We have not the ability to criticise in this place the numerous works and memoirs that M. Edwards published, and which touch upon all branches of the Zoological sciences, upon anatomy, upon zoology properly so-called, and upon paleontology, and which concern not only the mammals and birds, but the crustaceæ, the mollusks and the zoophytes. We shall mention merely, among his most important works, Recherches Anatomiques et Paleontologiques pour servir à l'Etude des Oiseaux fossiles de la France, the Recherches Zoologiques, anatomiques et paleontologiques sur la Famille des Chevrotains, the Etudes pour servir à l'Histoire de la Faune Mammalogique de la Chine, the Histoire Naturelle des Mammiferes et des Oiseaux de Madagascar (published in collaboration with M. Alfred Grandidier), the series of memoirs devoted to the extinct birds of Madagascar and the Mascareigne Islands, the Observations sur l'Organization des Limules, and, finally, the authoritative Recherches sur la Faune des Regions Australes.

The orators who spoke over the grave of M. Edwards extolled, as was befitting, the great scientist that France had just lost. Their remarks embraced everything that is wanting in this article, which ought to have been written by a more competent pen than ours.—E. Oustalet, in La Nature.

COLORADO MUD VOLCANOES.

OF the many strange and wonderful things to be found on the Colorado desert, perhaps the strangest and most remarkable of all are the mud volcanoes, of which little is known because of their inaccessibility, says The San Francisco Chronicle. Attention has been called to them recently because of their intense activity since the earthquake which visited Southern California on Christmas morning, and they are now spouting mud higher and more diligently than ever.

The action of these volcanoes varies almost constantly. They subside at times into almost a state of placidity, while again they will seethe and boil like vast caldrons, hurling showers of hot mud or sending columns of steam many feet into the air. The eruptions are preceded by explosions that can be heard for five or six miles. So far as known there are no other mud volcanoes in this country, and for this reason these are of particular interest to scientific men and others.

In order to get a good idea of the origin and location of these volcanoes it is necessary to give a brief historical sketch of the country. That the Colorado desert was formerly an arm of the Gulf of California there is little doubt. This was the case in recent geological times, as investigation has proved. At that time the Colorado and the Gila rivers flowed into the gulf about where Yuma is now located. The Colorado brought down a large amount of sediment from the country through which it flowed and deposited it on the desert, forming an enormous delta, sufficiently large to cut off the upper portion of the gulf and what is now the desert from the lower. At the same time there took place an elevation of land that helped cut off the sea. This condition has remained practically unchanged. The northern part of the desert is still depressed, the Salton sink being two hundred and seventy-five feet below sea level. The highest portion of the desert is on the Mexican boundary line, and the country slopes downward on both sides. The Salton sink afterward became a fresh water lake, which covered nearly all of the desert at one time.

The Colorado River next built up a flood plane around its mouth, so that its path was diverted and it flowed on over the deposit to the sea. The lake's source of supply being cut off, it dried up and only the sink, with its bed covered with millions of fresh water shells, remains to tell the story of the lake. It is thought that the drying up took place in recent times, as the Cahuilla and Dieguito Indians have traditions about the receding waters. The whole region is one of active volcanic disturbances, the biggest volcano being known as Sierra Priata, or Black Butte. This volcano has long since ceased to be active, but its huge crater remains. It was not a mud volcano, but was a regular volcano of the basaltic rock kind. It rises out of the mud plane a few miles east of the Cocopah Mountains, the base of the volcano mountain being five or six miles in circumference. The crater is perhaps three hundred and fifty yards wide and the bottom is now covered with sand.

South of the Sierra Prieta is the dividing line of the watershed. The Colorado overflows below Yuma, near Algodones, the overflow being the subsidence of the once great division of water. The water flows first southwest to nearly the foot of Black Butte and there divides, the New River flowing north into American territory, and the Hardy River south to the Gulf of California. The division takes place at Volcanic Lake. This Volcanic Lake is five miles south of Sierra Prieta, and a group of mud volcanoes are on its edge. Another group are near the south edge of the Salton sink.

These volcanoes were first heard of in the early '50s. There were a number of heavy earthquakes, so severe that Chimney Peak, a famous landmark near Yuma, was shaken down. After the earthquakes, the troops stationed at Fort Yuma noticed a cloud of smoke lowering over the desert. Major Heintzelman, who was in charge of the fort, started out with a party to make an investigation, and they discovered the mud volcanoes in active eruption. They were what are called salses, or eruptive mud springs, caused by an explosion of steam in the earth, which throws up the mud to a considerable height and builds regular cones. Ever since this discovery the volcanoes have continued active. Shortly afterward Dr. John le Conte made a trip to this strange country and published his investigations. He was followed by Dr. John Veatch, who visited the volcanoes south of Salton sink, and described them as being very active, throwing mud to a height of sixty feet or more.

At the present time there are about fifteen active volcanoes and twice that number that are quiet, hav-

ing subsided and left their cones. A large cloud of smoke hangs over the place, and there are a great many cracks and fissures in the earth, from which the steam escapes. The explosions can be heard for many miles.

Prof. David P. Barrows of the San Diego State Normal School visited these volcanoes several months ago for the purpose of investigating these strange freaks of nature. The overflow was very high at the time, and Prof. Barrows had to strip and swim the Hardy River, about one hundred yards wide, to reach the volcanoes. He found a number submerged in Volcanic Lake, and the others were on the mud plane just above the lake. It is the opinion of Prof. Barrows that the ground is fissured to the regions of heat, and the water percolating down becomes converted into steam and is forced up again with an explosive force, carrying mud with it. A number of volcanic gases, sal ammoniac principally, are thrown off with the steam. One volcano under the lake was very active, throwing up a big column of mud and water. On all sides was the sound of escaping gas. The soil was hard and baked and salt-incrusted.

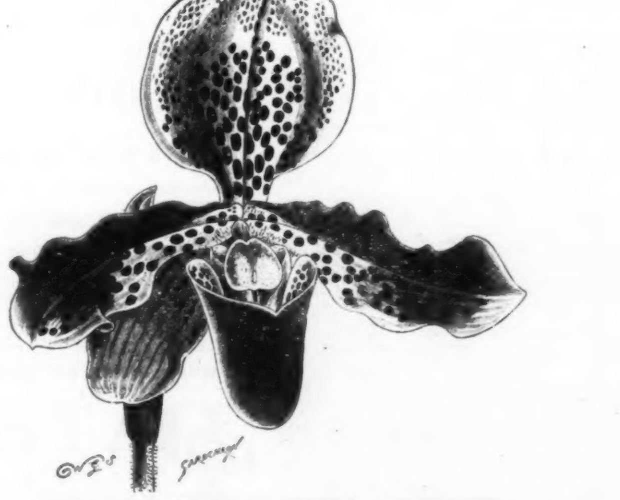
The springs were full of boiling water, and pools of water which had run off registered a temperature of from 115 to 130 degrees. The water was very salty and where it leached through the earth it left an absolutely pure deposit of salt. Prof. Barrows did not have his shoes with him, and found it difficult to walk on the earth because of the heat. This volcanic heat is a crustal heat, and geologists are not agreed as to what causes it. In nearly every region where there is a big delta deposit this crustal heat occurs.

This mud plane is very desolate and is surrounded by sandhills. The only vegetation is reed grass. A terrible pest known as the mosca fly abounds in the section. This fly will eat the skin from a mule or a horse, and Prof. Barrows found it necessary to plaster himself with mud for protection. He swam the Hardy six times, and on his second trip over he took his camera along, placing it on a raft, which he towed over by a rope held in his mouth. The largest of these volcanoes is about fifteen feet high, and in appearance greatly resembles a South American ant's nest. There are boiling springs and geysers in the Yellowstone Park, but nothing of this kind. It is rare to find springs in a mud plain.

Beau Hooker of San Diego visited the volcanoes three years ago and found them quite active at that time. He found that the mud and water had great medical value, which would render them equal to many of the famous healing springs. The volcanoes are rendered interesting by a fund of Indian legends and myths. The Cocopah tribe, who are the original inhabitants of this region, believe the volcanoes to be the abode of the evil spirit, and even to this day they approach them with mingled awe and terror. In earlier times it was the custom of the Indians to put their criminals or any white man who chanced to stray within their confines to death by throwing them into the volcanoes. This served a twofold purpose—it appeased the wrath of the evil one and rid the tribe of objectionable persons. These ceremonies were performed at night, and the weird, unearthly picture presented can easily be imagined. HARRY DEHM.

CYPRIPEDIUM × HERA, VAR. EURYADES.

OUR illustration represents the finest form of the many varieties resulting from crossing C. × Leeanum and C. Boxalli, and for which Sir Trevor Lawrence, Bart. (gr., Mr. W. H. White), was awarded a first-class certificate at the Royal Horticultural Society, it having previously secured an award of merit as C. × Euryades, but since that time had greatly improved. As with other hybrids between parents exhibiting great variations in themselves, there is great dissimilarity in the progeny, in this case as in others, resulting, perhaps excusably, in some amount of confusion in the nomenclature. Its beauty is not in question, its glossy, richly-colored flowers being among the best of its class. The upper sepal has a greenish base, a pure white



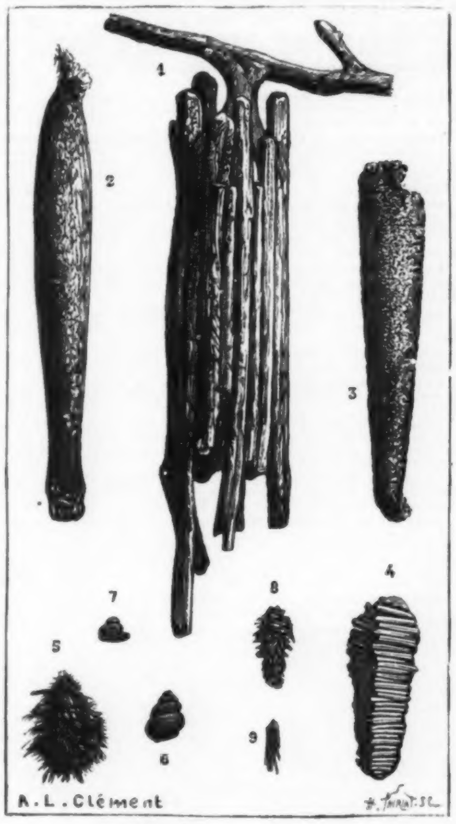
CYPRIPEDIUM × HERA, VARIETY EURYADES.

upper portion; the whole spotted with dark purple, almost black at the base. The petals and lip are greenish-yellow tinged with brown, the petals bearing dark purple blotches.—The Gardeners' Chronicle.

In certain towns in Wisconsin and Minnesota the electric light companies have laid systems of underground pipes through them, and have supplied steam heat and hot water to citizens. The companies enjoy a considerable revenue from what is practically a by-product with them.

TRAVELING COCOONS.

WHILE taking a walk one day in the summer of 1884 upon the banks of the Yang-tse-Kiang, in the vicinage of Han-Keou, in the center of China, we were astonished to see upon the willows, of which the trunks were laved by the "sun of the ocean," some fruits that we did not recognize as belonging to the order Salicaceæ. Our astonishment was increased when, after approaching in order to examine them, we saw the said fruits moving over the branches. Having collected



TRAVELING COCOONS.

1. Case of Eumeta Moddermanni (Delagoa Bay). 2. Case of Animula Sumatrensis (Amboyna). 3. Case of Eumeta Layardi (Ceylon). 4. Case of Psyche quadrangularis (Algeria). 5. Case of Psyche albida (France). 6. Case of Psyche helicinella (Pyrenees). 7. Case of Apterona crenulella (Paris). 8. Case of Psyche hirsutella (Paris). 9. Case of Fumea nitidella (Paris).

some of them, we found that we were the victim of an optical illusion. The elongated, gray, olive-like objects that we held between our fingers were nothing but silken cocoons covered here and there with leaves or small pieces of wood. Contrary to what we observe in the majority of cocoons, they were open at both extremities. At the larger orifice soon showed itself the blackish head of a caterpillar. This taught us that we had found here not cocoons, but what in natural history are more accurately named "cases," since "cocoons," properly so called, envelop a chrysalis. In the "case," on the contrary, are successively sheltered the caterpillar and the chrysalis. The perfect insect, if it is a female, will not always make its exit therefrom, but will oviposit in situ. As soon as hatched, the young larva forms for itself a protecting covering with the waste silk of the maternal envelope. In measure as it grows, it increases the diameter and length of its habitation, which it drags behind it as the snail does its shell. It results from this modus operandi that the thread of the case is not continuous, and consequently cannot be reeled. This silk might be utilized by carding it, but the Chinese scorn to do this, because they have at their disposal the beautiful and rich cocoons of the mulberry silkworm. At the moment of changing into a chrysalis, the caterpillar secures the cocoon to a branch by means of a loop of silk and then returns to the case, wherein it presents its head at the end where its posterior was previously situated. Here the ambulatory period of the insect's life closes. At the end of a few months the butterfly appears. If it is a male, it flies off on short pleasure excursions; but, if it is a female, its life is, as a general thing, wholly passed in the protecting case, from which it does not always make its exit, even for pairing. The female is, therefore, a very poor image of the soul, the name of which (Psyche or Animula) is borne by certain genera of these curious lepidoptera, but rather represents the cloistered existence of the Chinese woman, who passes her life in the woman's apartment and walks with difficulty with feet that have been compressed and transformed by fashion into shapeless stumps.

The female of the Eumeta Pryeri, which inhabits the cases of which we have just spoken, ventures forth scarcely more than does the Chinese woman of quality, since, by quite a rare exception in the class of lepidoptera, it is completely destitute of wings, and has legs that are so short as to be almost invisible. Although the Eumeta is not utilized for the silk of its case, it serves at least as food for birds, which are very fond of the insect contained in these ugly cocoons of gray silk.

A study of the Psychids has since revealed to us some cases much more curious than those observed at Han-Keou. The largest of all those with which we are acquainted belongs to a species indigenous to Australia (New South Wales). This is sixteen centimeters in length, and three in width in the center, and is partially covered with twigs of trees three centimeters in length and arranged in a parallel manner lengthwise and separated from each other by a space of from two to five millimeters.

Such twigs belong to the Melaleuca and Leptospermum, the leaves of which serve as food for the insect described by Westwood under the name of Oiketicus Saundersii. Other Oiketici of the same country construct cases, one simulating a ribbed fruit, another a pine cone, and still another, owing to the twigs that cover it, a small hedgehog. In the Proceedings of the Zoological Society of London for 1854, Westwood figured another case which was four centimeters in length by one in width, and which was perfectly cylindrical and entirely covered with twigs of equal dimensions. Two small bands of silk that encircled it near the two extremities gave it the exact appearance of a lictor's fasces without the ax, or, to use another simile, like a bundle of knitting needles. It belongs to Ceylon. Another constructor of the fagots exists at Delagoa Bay, in South Africa; it is the Eumeta Moddermanni. The silk of its case is completely covered with small pieces of wood closely compressed. This forms a sort of small bundle of fagots from four to five centimeters in length by from two to three in width. The twigs, although cut off square at the end at which the head is situated, are of unequal length at the other extremity.

Certain cases found in Java and Sumatra, and the twigs of which are nearly of the same dimensions, resemble packages of matches. They are the work of Eumeta Weyersi.

We have also seen cases that resembled in form, size and appearance a light yellow tissue paper cigarette. These are manufactured in Sumatra and Amboyna by the Animula Sumatrensis. Contrariwise, the Eumeta Layardi constructs a case with the form and color of a small Manila cigar. Collectors of cigar stumps would certainly take them for such objects forgotten upon the trees.

The most curious and most perfectly constructed Psychid cocoon that we have had an opportunity of seeing belonged to the Psyche quadrangularis, indigenous to Algeria and Persia. Its form is that of a small truncated pyramid entirely formed, externally, of stalks of alfa very closely pressed against each other, and forming a quadrangular structure. This very remarkable construction reminds us somewhat of the geometrical sense of the bee. As a general thing, it measures from two to two and a half centimeters in length by eight in width at the base and from two to three at the summit. We have recently seen a Psychid case of Brazil, eight centimeters in length and entirely covered with small hollow pieces of wood, arranged across the cocoon and forming a nearly octagonal envelope. The insect is unknown to us.

In France there are numerous Psychids of small size that live, as a general thing, upon grasses, but sometimes also upon lichens and mosses. In the latter case, the cocoon is formed of pieces of these plants; so the people of certain regions call these cocoons "walking moss." The scientific name of the insect that constructs them is Psyche albida.

An Alpine species (Psyche tenella) which covers its habitation with brilliant spangles of mica might consequently be called the "walking stone." In the Pyrenees, the Psyche helicinella lives in a turbinate case closely simulating in form and color a small black snail; whence its specific name. The case of another and much more widely distributed species, the Apterona crenulella, is greatly depressed and might be taken for a small fresh water Helix.

The pretty names of Psyche, "soul," and Animula, "little soul," given these lepidoptera, might cause it to be supposed that the wings of the males must possess colors in harmony with those of the flowers and birds of the countries of the sun; but such is not the case, for such butterflies are generally of a dull color—grayish or brownish, and sometimes, though rarely, whitish with a few figures. Owing to such plain tints and the small size of these curious insects, the latter in most cases escape notice. They pass like a puff of air, and vanish and disappear like a shadow. It is rather herein that the cause of the name that has been given them must be sought.—A. A. Fauvel, in La Nature.

CRAB RAVAGES IN CHINA.

IN the "Kwoh-Wu," or "Good Words from the States," attributed to Tso Kiu-Ming (6th century B.C.), a king of Yueh (now the province of Cheh-Kiang) is said to have been advised by his counselor to postpone his warlike preparation with "good words," in which the officer adverts to the "Rice Crab (*Tau-Hiai*)

that spared for man not a seed [of rice] in late years." A Japanese naturalist, Aoki Kon-yô, quoting a Chinese work, "Ping-Kiang Ki-Sze," speaks of a crab devastation which took place in the Wu District (now Kiang-Su) in 1297 A.D., "when all plains were full of crabs, wasting all crops of rice." ("Kon-yo Manro-Ku," written 1763, ed. 1891, p. 164.)

Twan Ching-Shih (died 863 A.D.) briefly speaks of this crab thus: "In the eighth moon of the year, the crab has in its belly an *ear*, really that of rice, about an inch long, which it carries eastward as a present to the 'God of the Sea'*; before the carriage is accomplished, the crab is not edible" ("Yu-Yang Tsah-tsu," Jap. reprint, 1697, bk. xvii. fol. 4, *a*). Contemporaneously, Luh Kwei-Mung (died *c.* 881 A.D.), in his "Notes on the Crabs" (*ap.* "Yuen-Kien-lui-han," 1701, bk. 444, fol. 18) narrates: "These crabs live in holes, which they dig in bogs, until the season that intervenes the autumn and winter, when they emanate from their homes. The people of Kiang-Tung say, when rice is ripening, the crabs take each one ear in order to pay court to their chief. Every morning and every evening they all run toward the river, when men fish them by setting wiers across the affluents. Yet six or seven out of ten crabs would pass over the dams, and in the river they grow larger; whence they proceed to the sea in the same manner as their previous march, also being persecuted as before, which, however, they escape with more skill than in former occasions." Later, in the dynasty of Sung (961–1279 A.D.), appeared a "Monograph of Crabs," by a certain Fu Kwang, who relates in it: "In the crevices on rocks along mountain streams occurs a small crab, red and hard, and so named *Shih-hiai* (Stone Crab). When still young, in midsummer, owing to absence of any edible cereals, it feeds on the root of reed, whence its name *Lu-kan-hiai* (Reed-root Crab), and is meager in size and taste. About the eighth month it grows larger after moulting, and, when rice or millet is mature, every one crab bellied with one spike of the cereal runs to the river, when it is termed *Loh-Hiai* (Merry Crab), and is very fat and best to eat. Thus it goes to the sea where it presents the spike to its chief" (*ibid.* fol. 19 *a*). These are very good samples of the celebrated celestial whims, which once expressed, no literatus doubts; for, to me, it is too clear that the tribute which these so-called "grain crabs" are said to pay to their king is nothing but their spawn, which they carry under the abdomen to lay down in the sea.

I do not know whether the rice-carrying crab is the same with what devastates the plantations, as is supposed by Aoki (*l. c.*), although very probably so. And I shall be very much obliged if, through your medium, some one will answer my questions: (1) What species of crabs is the cause of such stories? and (2) Is such a crab-ravage reported in modern times from China? From De Rochefort's "Historie . . . des Iles Antilles," Rotterdam, 1665, p. 255, I gather the renowned Violet Land Crabs of the West Indies to make some damage to tobacco farms, but not to grain as is so vastly attributed to the Chinese crabs; while F. Legnat, about the end of the 17th century, described a land-crab of Rodriquez, whose destructive power during its emigrating period appears to equal that of its Chinese kin (see his "Voyages," ed. 1891, p. 92).

Yu Pau (4th century A.D.) writes in his "San-shin-ki:" "In the year 283 A.D. all crabs in the District of Hwui-Ki were turned into rats, whose group covered the rice farms and made an extensive devastation. When yet immature, these rats had hair and flesh but no bones, and unable to pass over the ridges in the farms, but became vigorous after a few days." The erroneous exposition, to account for the origin of rats or field-mice, would seem partly to originate in some similarity of the fur of rats with that of the so-called Hair-Crab (see Stebbing, "Crustacea," Pl. III.), but more in the people's familiarity with the land-ravaging crabs† in ancient times.—Kumagusu Minakata, in Nature.

LINING MINING SHAFTS.

IN a discussion on the lining of mine shafts in the Liège Association of Engineers, M. Grosfils, general manager of the Fontaine l'Evèque Colliery, who introduced the subject, remarked that in shafts he had always obtained good results with oak planks 7 cm. (2¾ inches) thick and 10 to 15 cm. (mean 6 inches) wide with double T-iron hoops spaced 75 cm. (2 feet 5 inches) apart, an arrangement which is comparatively cheap and easily put in, while it affords a certain amount of elasticity that permits a little yielding to movements of the measures. M. Collin advocated brick lining on the score of both cost and durability, and M. Pépin, as regards maintenance, gave the preference to stone. M. Bougard called attention to the good effect produced by tarring the timbers, those in return always especially lasting three times as long when tarred as they would otherwise. In reply M. Grosfils acknowledged that the increasing dearness of timber might modify his views as to that material, and he agreed with M. Collin that the use of mine timbers ready cut to length had great advantage over the obtaining of supplies in the rough, as regards ease of checking and stocking, together with a very appreciable economy.—Engineering and Mining Journal.

Arsenic in German Fabrics.—According to a report from Consul Hughes, of Coburg, dated April 5, 1900, a contention has arisen between German exporters and the Swedish government, the latter asserting that there are traces of arsenic in textile materials exported from Germany, such as carpets, wall papers, furniture covers, toys, etc. The German manufacturers claim that this is not so. In one way, says Mr. Hughes, this will be a strictly chemical fight, as the Swedish officials will say that their examinations were properly made, and the Germans will insist that if arsenic was found, it was due to the use by the Swedish chemists of impure chemicals in making the tests.

* The Japanese who worship the deity of Kotohira (the patron-god of mariners) taboo the eating of crabs.

† The "Hair-Crab" of Japan is caught in the same way as the Chinese mode of fishing the rice-carrying crabs. The Japanese well know its descent down the river in autumn, and have well noticed it never to reascend it afterward as some fish do (Kaibara, "Yamato Honzo," 1708, bk. xiv. fol. 48), but never possessed a belief in a crab carrying grain to the sea. Only one case that slightly approaches that of the latter, I find in "Hokuso Sadan," where it is narrated that, near the end of the last century, the river Yodo, near Kyoto, was one day so swarmed with small crabs that every handful of water was full of these creatures.

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